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State Council of Defense
(Pa.)
Proceedings of Plant
Protection School
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COMMONWEALTH OF PENNSYLVANIA
STATE COUNCIL OF DEFENSE

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Proceedings of
PLANT PROTECTION SCHOOL

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Transcript of Lectures Presented
at Three-Day School in
Philadelphia, November, 1941

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STATE COUNCIL OF DEFENSE
CAPITOL BUILDING
HARRISBURG, PENNSYLVANIA

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FOREWORD

The State Council of Defense has recently held two Plant Protection Schools for the purpose of instructing representatives of valuable industrial, educational, commercial, health, and public buildings, how to protect their buildings and personnel against enemy attack from the air or from within.

The first school was held in Philadelphia at the University of Pennsylvania, on November 20, 21, and 22, and was attended by over 800 delegates.

The second school was held with a similar program for representatives in the Western part of the state in Pittsburgh, on December 4, 5, and 6, at Carnegie Institute of Technology.

Since the schools, there has been a wide demand throughout the state for copies of the lectures and proceedings and we are happy to offer this material in this volume. Additional copies may be obtained upon request from the State Council of Defense, State Capitol, Harrisburg, Pa.

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GREETINGS*

By F. H. LaGUARDIA

U. S. Director of Civilian Defense

Dr. Marts, ladies and gentlemen: I didn't want to leave Philadelphia without expressing the appreciation of the Office of Civilian Defense for your interest in taking this course.

I suppose you have heard it stated so many times that the new technique of modern warfare has made necessary new measures of defense. At one time, cities were reasonably safe. Now, every city is a target, and many cities a very attractive target. War today is not confined to military or naval action. The strength of a nation is no longer measured by the strength of the army and the navy.

It is rather an industrial contest. Which of two nations or which of two groups of warring nations can produce and continue to produce the greater amount of the necessary weapons used in modern warfare? And these weapons draw from the internal and other resources of an entire country or group of countries and depend entirely on their capacity to produce them.

> **Therefore, an industrial city becomes a legitimate target of attack. Whether we like it or not has nothing to do with it. It's a fact, and where an attack can be made to retard production, that center is sure to be attacked.**

Now then, we do not expect for the present long, sustained, repeated air attacks, but we must be prepared for short, sudden, surprise attacks. It becomes, therefore, necessary for every plant to take every possible precaution, and as we train civilian defense forces, each plant and each factory should have its own air raid wardens, its own fire department, and its own medical squads.

If each factory has this service, it will reduce the work or the calls on the regular functional departments of a city. In addition, of course, it will reduce loss of life and property.

> **One of the very first responsibilities that you will assume as leaders in the protective service of your plant or factory will be that of disciplining your own personnel.**

I assume, of course, that a very careful study will be made of your plant; that it will be surveyed; that you will know exactly where you want the employees to go in the event of an air attack; that they will be trained in making the exits in the event of a fire or explosion; that you will train among your own employees a sufficient number in first aid and also a number of them for more advanced rescue and medical work.

The American Red Cross will provide the first-aid courses. A large number should take that, and out of those you should provide a certain number to take the advanced or hospital course as a nurse's aid.

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* Director La Guardia appeared before the School on the closing day, November 22.

That is very necessary, because your plants and factories may be located at some distance from a base hospital, and it becomes very essential that out of your first-aid workers you have some who have taken a more advanced course and know what to do in the event of a severe injury.

You will also have to prepare and train your auxiliary fire forces, and that becomes very important, in the use of sprays and chemicals and also managing pumpers of your own local fire brigade.

Your air raid wardens will have the responsibility of grouping the employees, of directing them where to go or what to do in accordance with the particular and physical condition of your own plant.

It may interest you to know that at the very beginning of the war in Great Britain during a raid all factories were evacuated. The Nazis learned of that, so they kept up a continuous raid on a center, even with a few number of planes. Most of the English workers now do not abandon their bench or work during a raid. **It's a wholesome discipline, and your chances of being hit or killed are greatly reduced by being spread and remaining at your bench or at your work.**

There is just as little chance of being hit in one particular place as there is in another. And, of course, the idea of grouping workers in a large plant that's detached has been abandoned in Great Britain, because if bombs should strike there, the loss of life is very heavy.

So one big thing you must remember is to discipline your employees so as to avoid panic. That's your big job, and that you can do by constant drills and bulletins and instructions as to what to do, and impress upon them—you take any large plant from five hundred to a couple of thousand men and women, all rushing for one exist; you could readily see what would happen.

> **That has to be drilled into them and drilled into them day after day. And at the end of a shift, there should be repeated drills, fire alarms, bombing alarms, so that they get accustomed to the alarm, and it doesn't unduly excite them.**

We are able in our schools all over the country to train children so that they do not become excited or panicky when they hear an alarm. They don't know whether it is a drill or a real fire, and we have been very fortunate in this country. There is a reason for it all. If you will look around here, you will see "Exit," "Exit," "Exit." Why? Because if a fire were to break out here and everybody rushed for one exit, the loss of life would be very heavy.

Statistics will show that the loss of life in theatres or places of assemblage in fires is greater because of panic than of the fire itself. And that is why for the last quarter of a century fire departments have been educating the public on the programs and in signs, **"In**

case of fire, choose your exit. Walk, do not run." That's why we mark these exits. The tendency is in case of panic to rush for the nearest one.

That is what you have to drill into your employees in your plants. Each man must know exactly what he is to do and where he is to go in the event of fire, in the event of an attack.

Now I don't want to be alarming, and you don't want to be alarming. This is only a precaution, a potent precaution. As I say, the technique of warfare has changed. In the last war we could fly a couple hundred miles and drop a few bombs and come home. Now they can fly thousands of miles.

We cruised at a speed of about 100 or 105 miles, loaded; came back empty, perhaps 115 or 120 miles. Now a bombing plane will cruise 350 miles. Where we carried pounds, they carry hundreds of pounds. We are flying planes every day from points in the United States and Canada to England, and the distance from there to here is no greater than the distance from here to there.

So we must be prepared, and because of the nature of the attack, because of the objectives, every plant and factory becomes an objective in order to retard or reduce this production which is so necessary to modern warfare.

> **It becomes essential that each plant and factory provide its own air raid wardens, its own fire auxiliary forces, and its own medical squads.**

You ladies and gentlemen who have come here will have had the advantage of experts who have made a study of this problem. I want to congratulate you and through you to express the thanks of the Office of Civilian Defense to your companies, to your plants and factories for having the foresight and the wisdom to take the ordinary, necessary precautionary measures for the protection of their own plants and, what is more, of their own personnel in order not to stop production.

We can get out of this mess, I believe, easily, if we can only produce enough in our national defense program. There should be no stoppage; there should be no retarding of our production for any reason whatsoever!

I want to thank you very much.

INTRODUCTORY REMARKS

By A. C. MARTS

Executive Director, State Council of Defense of Penna.

One of the most difficult things you will have to contend with when you go back to your communities to put into effect the protective measures that you are hearing about here will be the indifference of your associates. When you go home, you will be alert to the dangers, but the first thing you will encounter will be an attitude on the part of many of your friends and associates who will tell you that it is ridiculous and folly for you to expect any of these dangers or hazards.

We who have been working at the Civilian Defense Program for the past several months realize that this has been our chief resistance, and you are going to encounter the same; but you must go forward resolutely in spite of this resistance and take the protective steps that you know should be taken. Perhaps it is folly. Let us hope it is, but let us be prepared in case these dangers do happen.

Those who know tell me that **four enemy planes can do as much damage over our nation as a hundred do over England.** The reason for this is that we are unprotected. We do not have any anti-aircraft guns protecting our buildings, nor do we have any captive balloons. In England, where the captive balloons and the anti-aircraft guns keep the enemy planes thousands of feet up in the air, it is impossible for them to aim their bombs accurately at the targets below. But here, without that protection, the enemy plane can dive-bomb within fifteen feet of its target.

It is for this reason that four planes can do here the same damage that a hundred planes are required to do in England.

Therefore, the enemy does not need to send many planes over here to inflict serious damage. Four planes could come over, drop their bombs, land in an empty field. The crew could get out, set their planes on fire, and then walk into the nearest town to see the movies. The worst that could happen to them would be that they would be arrested and interned.

Now if the enemy had sent a hundred planes to bomb England, they would have lost ten of them; but they sent the equivalent of four to bomb us and lost only four. Therefore, **we should not feel complacent at all about the three thousand miles of sea that separates us from Europe,** but rather feel very much alarmed about the lack of preparation here to protect ourselves against these dangers.

* * *

The school at the Edgewood Arsenal is conducted by the Chemical Warfare Division, giving a two weeks' course. And I should think that **many of you, after you get home and begin to make your plans for your responsibilities, might feel that you could profit from a two weeks' attendance at that school.**

If you yourselves can't get away for two weeks, I should think you might arrange so that one person, one fireman or some other official person in your community, should surely go there and bring back to you and to others in your community the methods that are learned by these men in attendance at Edgewood Arsenal.

The course is free. The only charge in connection with it is a small charge for living expenses while there. I think the living expenses, board and room, are something like twenty-five or twenty-six dollars for the two weeks; and, of course, **all delegates must be officially sponsored by their local mayors or burgesses or fire chiefs.**

The nominations are sent to me at Harrisburg by a mayor or fire chief or some official of a local unit of government; I pass them on to Colonel Lisle; he passes them on to the Arsenal, and in the course of time, after investigation of each nominee, they are invited to come and spend these two weeks.

We have three or four people here in the room today who have been there. We have, for instance, one school superintendent who took the course and is now using the knowledge he got there to organize the safety of his own two thousand schoolchildren; so it's not only a course valuable to firemen, but to all the rest of us.

INDUSTRIAL COOPERATION

By The Hon. LEWIS O. BARROWS

Former Governor of Maine, Representing the U. S. Office of Civilian Defense on Industrial Plant Protection

According to the United State census of 1939 there are 13,802 industries of varying sizes in Pennsylvania. While that figure may have fluctuated somewhat since the last census was taken, these sessions demonstrate that you are fully aware of the importance of your industries—and that the subjects to be considered here for the next three days indicate your determination to take all possible precautionary steps against damage from possible events or conditions we all hope **may never happen here.**

I would also add at the outset, that the Office of Civilian Defense in Washington fully approves of the school of instruction that has been organized here and urges that you consult with your local State and community defense organizations frequently in perfecting your own organization—to the end that closer coordination may result.

You men who assemble here today come as carefully chosen representatives of Pennsylvania industrial plants. You have been selected by the management of the various industries for a very responsible task, although one possibly not pleasant to contemplate.

As you so well know, we are engaged in an effort of "all out" production under conditions officially proclaimed as a "national emergency." We are trying to produce more and expanded production, which naturally means more people are at work—concentrated in various factories.

> **We want not only to afford these skilled employees all the possible protection we can, but also to take similar precautionary measures designed to protect property and prevent disruption of production schedules.**

Your State Defense Council was created to better coordinate all these efforts. Their function, as I see it, is to take such steps as can be foreseen that are calculated to protect **all** the citizens of this State in times of emergency, such as we realize we are now faced with.

As we go about this grim business you realize, I'm sure, that we do not have any time-tested American pattern to follow. While we do have knowledge of some measures that have been tried out in England to serve us as a guide, we shall, in the final analysis, rely on the genius of the American people to meet this or any other crisis—once they are aroused.

In an emergency condition like this it is only natural that almost the first question that presents itself would likely be—**"What Steps Should We Take?" or "What Plan Should We Follow?"** Therefore, to assist you, and at the same time to promote greater uniformity in preparations, there is presented an "Emergency Plan for Protection of Industrial Plants and Public Buildings."*

Although the outline which you now have is a partial answer, you must remember that **no one set of suggestions will automatically cover every plant or every situation.**

Furthermore, future conditions may indicate certain revisions. However, it does represent the best available thought at the moment. Combined with your own ingenuity and knowledge or your individual requirements, the present outline should make your problem easier of solution.

Moreover, it is a plan that is susceptible of modification in order to meet the requirement of different sized plants, hotels, colleges, churches or institutions of either public or private character.

Specifically, the outline which we have before us was developed to provide protection for plant personnel and property from bombing, explosion and fire. Naturally, it follows in many respects the general outlined plans for an air raid warden organization for cities and towns because perfection is only attained when complete coordination is accomplished. Remember that if bombings, explosions or fires do occur, it affects all alike, and like the rain, descends on the "just as well as the unjust."

So, therefore, there is a **joint mutual responsibility** to recognize as you proceed in these sessions. Cooperative action is essential. Experience has shown that **where there is proper preparation, loss of life and property may be materially reduced.** But an industrial plant cannot hope to offer adequate protection against any of the causes mentioned unless care is exercised in planning, and general cooperation of **all** employees is obtained.

It is the duty of management to carefully inspect its industrial plant or buildings and then adopt such measures as are designed to afford maximum protection from damage from bombing, explosion or fires; and the success of all this depends upon the willingness of the employee to fully cooperate.

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* Copies may be obtained through the State Council of Defense.

And, remember that this means a **general** cooperation—because **there is no difference in the responsibility of management of industry and the ordinary householder in civilian defense except one of scope and the degree to which they apply.** Failure on the part of either one—management, or employee, or citizen—might result in nullifying any effort of the other no matter how thorough the preparation had been.

Remember, also, that in civilian defense organizations there should be a place, a function, for all the people employed in your plant. It is presumed that you, as the plant chief warden or defense coordinator, if you choose to call him that, will select for each key assignment the man or woman you feel is most efficient for that place. These selections should be carefully made. Temperament, natural leadership, and ability to act effectively under great stress are certainly important features to hope for.

Having done this, you then should clearly outline to these persons what is expected of them. **Do not assign multiple duties to any person if it is possible to avoid it.**

> **You will find it to your advantage to decentralize squad leaders to insure complete coverage under all conditions. Of course, in the event of different "work shifts," a separate organization for each "shift" is necessary—as are deputy leaders or wardens—if your organization is complete.**

You may decide you want to provide some sort of special identifying insignia. Many plants have adopted this feature believing that such identification would inspire confidence and tend to stimulate a healthy interest in general plant activities.

Having perfected your required organization, **the next step is frequent drills and inspections.**

To illustrate what is meant for inspections: It is not enough to say, "the conditions on the second or third floor of my plant are all right because I was up there this forenoon or yesterday, myself." It is safer to assume that conditions may have changed—and they have been known to change, either by accident or design. "Keep Alert and Stay on Guard" is a sensible motto to adopt and practice.

In preparing for the unexpected—if that expresses it—discipline and maintenance of morale may become a major problem. Consider now for a moment that an emergency should arise in your plant, one that might easily increase in intensity very rapidly. Then the prevention of panic or fear could not be too strongly emphasized. Keep in mind we are discussing the features of a voluntary organization. There's nothing compulsory about it; hence the value of cooperation is all the more evident.

Again, you can well appreciate that **the lack of a complete understanding of fundamental precautions would only result in either widespread excitement, a stampede or general "milling about."**

To further illustrate, disregarding for the moment any possibility of bombings, assume that your plant is operating to capacity, giving employment to several hundred persons, or you are conducting a large business establishment. Suddenly, with little, if any, warning, any one of the following possibilities may occur:

> **(1) Lights go out. (2) Power is shut off. (3) Crowded elevators stop beneath floors. (4) Communication system cut off. (5) Water mains broken. (6) Your plant is on fire in several places, etc., etc.** In other words, things that **might** happen actually **do** happen. What would you do?

Without question, you would welcome at that point such an organization on the spot—trained, equipped and ready for action.

Thus the importance of all your employees knowing what to do, or how to act, when bombs drop or explosions occur, or fires start, need not be argued. Yes, **all** must be trained to act quickly if injury or confusion is to be averted.

Perhaps you may say: "Why, all these things are fundamental." True enough, but often times it is the necessary fundamentals that are overlooked when sudden conditions like these occur. In all such cases **time** is the essential element.

As these sessions progress you will observe the fact that you are frequently referred to as a unit. That may be either an individual unit—an industrial unit—or a municipal unit. In any event **you probably can never become an effective unit under conditions cited herein unless you start to recognize the importance of planning and training.** Training makes skill, and skill is necessary to survive—certainly under present conditions.

I have attempted to indicate that there is available to you a definite, workable outline for an organization at your plant. You, the management of industry, or their representatives, may well view the plan as something of a guide to protect your employees and invested capital. **You can likewise regard it as a form and kind of voluntary insurance you can ill afford to be without.**

It is all presented in deadly seriousness and in a dispassionate manner. If you never have an occasion to depend on such an organization, you have lost nothing. On the contrary, when you do need it, the need may be a desperate one, and it may come without too much warning.

You may possibly encounter some people who view lightly the necessity of any action along lines herein suggested. Do not let that alter your determination, because **the time may come when such a person will be the first to need assistance.**

Furthermore, do not leave your enthusiasm for continued "industrial protection" here when you depart to your home or go to your respective plants.

AIR RAID WARDENS

By HOWARD JOHNSON, Manager, Midland Shipbuilding Corp., Midland, Ontario, Canada

In coming here today, I wouldn't like to create any false impressions. I don't know your problems. I know what our problems were in those early days, the days preceding the outbreak of war and the days immediately following the outbreak of war; and if I can be the medium of translating any of those experiences to you as representatives of a great nation, then I will have counted my task well done, for the people of Great Britain undoubtedly look westward today for their salvation.

You may consider that a form of weakness. I would suggest that **it is not a form of weakness so much as a form of strength, for one naturally looks, when in distress, for assistance from blood relations.**

In those early days, the first problem was for all of us in Britain to realize that there was a war in progress. You will recollect that phase, to use an American expression, the "phony" period, the period when armies were massed in Europe, supposed to be opposed to one another, but nothing happened.

On looking back, it would appear as though our Government also were unaware. While we heard one or two brave souls lift their voices to warn us, notably our present Prime Minister, you've got to remember that a slightly earlier background was entirely devoted to peace; and **after you've spent years thinking only in terms of peace, it is not an easy matter to suddenly switch over to the violent thoughts of war.** That is largely why we found it exceedingly difficult to ever take Civil Defense seriously.

Civil Defense was unknown in our country in the intervening period between the Napoleonic Wars and the present day. We felt that there was nothing simpler in having the Navy than to keep any foreign power away from our shores. Our history taught us that. We grew up in that conviction, but the facts were all wrong.

The facts were that no longer were we clear of violation by that ditch known as the North Sea. The bomber had come, and the bomber always gets through.

The government sent out pamphlets advising the public what to do. Certain instructions were issued telling us what we had to do, but great compulsion in a democracy is not practical; so the public really was not guided as they should have been at the time when their minds were divided. The result was that the mental division remained, and nothing divided against itself like that could continue successfully on any path it may choose. And so Civil Defense languished.

It really started in 1938 with the September Crisis. There was a perceptible movement then to prepare for bombing attack and invasion, but that dwindled away in that stagnant year to practically nothing. And then you will recollect when Mr. Chamberlain spoke over the radio on that Sunday morning, and we realized we were at war. Hardly had he finished speaking when the air raid sirens sounded throughout Great Britain.

That was a time, a momentary time, when many people sincerely regretted their previous inactivity. We did not know whether, in fact, an air raid was coming that very moment while the sirens were sounding, and we knew in our hearts we were not prepared.

The general reaction in the district where I was was to remain silent. You might say we were silent because our own words were thrust down our own throats by that wailing sound.

Now Civil Defense from my angle is really air raid precautions. When I think of the lost time in the past in our country, I think how we quarreled and argued and debated about what today we know was automatic.

Civil Defense can only imply mutual preservation of a community against disintegration, a whole community dedicated to the protection of one another and the entire welfare of that community. If it doesn't mean that, then don't have anything to do with it. That's what it turns out to be in practice.

Now as we simmered along in the first years of the war, the true realization actually only came to us as to what was simmering when the Dunkirk situation arose. From that moment onwards, people were aroused.

I should make a correction here. I was not on the city A. R. P., but on the local A. R. P., which you'll see was built up for a specific purpose, affecting industrial plants in a very important area. Now each plant had its own Civil Defense. That comprised the control office and control officers, the chief warden, the warden's fire services, demolition squads, rescue squads, decontamination squads, ambulance services, and the other organization which goes with it.

But the next step was a thought process. Do we really think that the bomber is going to single out this or that particular plant?

Well, it requires very little thought to realize that while the bomber will always try to pick upon an individual plant in a highly industrialized community, he isn't going to concentrate upon that plant solely, but **anything within a highly industrially organized district is a natural military target today,** because in a war such as this, everything, every aspect of life, from happiness within the family circle to the finished product of munitions, is part of the war effort.

So the first thing we did was to call all the employers in that specific area, which was a huge docks area, one of the biggest coaling districts in Great Britain—an area which comprised shipbuilding plants, oil refineries, gasoline storages, heavy engineering, timber dumps to make props for the colliery workings and the great coal handling plant and many other smaller subsidiary industries.

In calling that meeting, we laid before one another the fact that if a really comprehensive raid took place, each A. R. P. service would be functioning independently of one another. It may very well be that some particular plant had all its services idle in the midst of a very great raid simply because a bomb had not fallen on their particular plant; and it was agreed that the district was a natural one for district organization; and that, I think, is a very important point for all industrialists to remember.

So we appointed plant committees which sent a representative, and preferably the chief warden and the control officer, to represent them on the central committee, which involved the whole control of the area. And this may be helpful to you—the approach to the employees. One has to be frank when matters of life and death are involved.

The death of an employee is just as important to a particular family as the loss of a power station is to a community. It's a matter of degree, and so **the first thing we did was to ask all the men to meet the management with a view to appointing a committee which would be democratic, which would represent all shades of opinion, so that this organization would be built up with the entire consent of all those employed in the entire district.**

The result was that we had one or two very fine men speaking for the employees and for the management and for the owners of the particular plant. Very quickly we held meetings in the various plants, explaining the dire urgency. And such points as this arose in these meetings: Well, what about the protection of our wives? If there's a raid on, we want to get home; we want to look after our children and our wives. How can we stay on here when we know the town is being blown up?

Well, the answer to that is very simple. Without the means of production continuing, the means of defense cannot proceed. The chances of getting from one's work to one's particular domestic locality in times of an air raid are remote. So far as the domestic considerations arose, the civic authorities themselves were organizing A. R. P. so that the families of all workers were protected and cared for while the wage earner was occupied with the production of munitions, ships, handling vessels, and the various things that go to make the war effort.

And I must say that these logical things were accepted very readily. The view was held, "Very well, we'll give it a trial because something has to be done quickly."

Those committees in sending their representatives to the central committee for the whole area always gave their representatives plenary power to settle quite voluntarily any major problem that arose in the district. And to cut a long story short, **we pooled every one of our resources from the human resources down to the material resources.**

The first thing that had to be done in grouping industries like that in a particular area was to have an entire survey of what equipment we had ourselves for defense. That survey included rivet bags. Those of you connected with shipbuilding know that rivets are sent in bags, as a rule. Those bags became very important. Usually they are discarded. We filled them with sand from the beach. You'll see the importance of those bags. All our fire-fighting equipment was scheduled, even buckets, ordinary water buckets were scheduled, until we had a complete picture of the entire equipment of that district.

We found that in some cases we had more equipment than was necessary; in others, too little. But it was felt that the Government and the local authorities had their hands so full that to set up a howl, asking them to help us with equipment was a waste of their time and ours, because suddenly **in an emergency you could not supply entire districts with expensive equipment at a time when the urgent thing was munitions.**

We felt clearly that what we had to do first, and this is very, very important, was to show clearly every step on our part was complete, was ready, and that our only shortage was not one of neglect, but one of deficiency in the field of equipment. We felt also that the urgency was so great if we could develop equipment ourselves, then we should do so.

> **The question of expense looms up, but in a measure it was met by this: What is the expense of supplying equipment, which is going to cost you such and such, compared with the expense of having to replace your entire industry because of lack of that equipment?**

So we supplied ourselves with whatever equipment we could without wasting time. Time was the factor in pressing the Government to divert essential industries to what undoubtedly were essentials, but not quite so essential as those required to stop invasion or to stop this bombing which was going on.

Later on, when we showed we were a comprehensive working body, then the Government gave preference in its allocations to those who were organized and had done something and definitely could function.

We trained with what equipment we had, trained everybody, so that when their new equipment came, they hadn't to start training. It was ready and could be brought into use.

Well then, the question was that raids came any hour of the twenty-four; but certain plants cannot function at night. As you realize, there is a blackout which is terrible in its intensity.

Therefore, certain industries cannot function, notably the outdoor industries which require outdoor lighting. There are great timber yards in our area. They had to be patrolled. An incendiary can fall, and it cannot be seen. It's lost, until suddenly you are met with a conflagration of such magnitude that it's too late to deal with it. It's too late to deal with it in a normal sense. It requires perhaps the entire fire-fighting services of the entire community to deal with that local thing. Therefore, they had to be patrolled incessantly by men trained in handling incendiaries.

You know an incendiary bomb is probably nine inches long by two inches in diameter, and the sky is a very big place. **A plane may be out of sight, behind a cloud, and still drop an incendiary, probably drop ten.** In the ordinary-day world, if they come down in certain areas, you don't know they are there until the fire is a fact. So all that area had to be covered.

The next question was: Who was going to cover it? Who would have to be paid for covering it? Well, that's where I say the response of these committees was heroic. There is no other word for it. Because nobody was paid for that. Employer and employee took his part in whatever the committee decided. It sounds like dictatorship. It's not. It is discipline voluntarily imposed upon one's self. If dictatorship means that, then surely that is the highest form of dictatorship—to dictate to one's self.

We provided bunk houses—that is, sleeping quarters—for this personnel so that they could go out in patrols and meanwhile rest; and the next day they went on with their jobs.

> **The voluntary response was so great that no more than two evenings per week were allocated to any one man. In short, the more people who are responsible people, the less work each individual has to carry in times of distress.**

Then, as each individual firm was supposed to have its own ambulance stations and did, it was realized that casualities would be great and that ordinary considerations of accidents within the works wouldn't meet the case; and because we had organized collectively, we were in a position to approach the authorities and say, "We represent such and such a number of people, and such and such a measure of importance industrially. Will you allocate on call certain medical attention, including ambulances? We have our own clearing stations, we have all our services organized, but we cannot deal with major cases which require immediate surgical attention."

And they said, "Yes. As soon as the yellow warning comes, medical men will be immediately sent into your district because you have organized. Those that you can retain at your clearing station, do so; but those medical men will decide which have to go to the hospital."

You'll see that was a very simple solution which would not have been attained if each firm had been acting independently. It was the same with the fire-fighting equipment.

The survey that was made there indicated, particularly in connection with the oil refineries and the gasoline storage, our equipment could not cope with a major conflagration there; but seeing that the civic authorities were relieved of a great deal of fire protection by our efforts, **they promised, and carried out their promise,**

that special equipment would be allocated on call to certain sections of our district.

The next thing was the urgency of the matter. Against what had we to prepare and when? And having decided that, what was likely to be our greatest danger, and within our area which was the most vulnerable to attack, whether by sea or by air?

Having gone through the district that way, we decided that the greatest attack we had to face would be incendiary bombs, and undoubtedly that has proved to be correct. Where was it likely to affect us most? We came to the conclusion in the timber yards and the oil refineries, natural conclusions, but still, **unless you put those down on paper and deal with them accordingly,** as Governor Barrows said, **the fundamentals are frequently overlooked.**

So we organized on that basis, and the question of urgency was answered very simply. Perhaps the person who showed least enthusiasm was the first to regret it.

We had never had an air raid, but I personally had seen a plane over our plant every day for six days; and we ignored this plane because it was so obviously British, just a friendly plane, keeping his eyes open against possible attack. But we realized that his friendliness was a mere sham when he dropped a bomb on us, and then went out to sea very rapidly.

The bomb hit that very district, fortunately, where our friend who wasn't very enthusiastic had his plant; and so the urgency was brought home to roost. And it actually did take the first bomb to really put us on our mettle.

> **How stupid and foolish that all seems to be now! How futile to wait until you're devastated before you admit the likelihood, not only the likelihood but the immediate possibility, of being smitten, before you act! We acted then very quickly.**

Practice, practice, and more practice, until you're perfect and pluperfect, is the only answer that Civil Defense can offer to the conditions of world war. And it is no use assuming that war is going to be local, it's going to be here, it's going to be there. I'll tell you why I say that.

Britain is a small country, but there are wide-open spaces in it where a man can be lost for days on end. And lots of people who could not give a useful contribution or had not felt the need, cleared out of the allegedly dangerous areas into many of these areas. A lot of them are wiped out today in those areas—gone, blown up.

Now it's no use thinking that war is only going to take place in this area, or that area, or the other area. Where planes are transcontinental—I use that in the term of passing perhaps from one coast to another—anything in between is their target area. If a fighter plane attacks a bomber, very often the bomber has to release his entire load just where he happens to be at the moment of attack.

The fighter will travel at four hundred miles an hour, so he can cover some territory; and so can the bomber. You have to work on the basis that no area is safe. That means your rural areas, too, because there the tendency is to neglect defense. A plane will come down and machine gun people, and people from the housetops will level at it.

One can imagine many things, but let's stray from the realm of imagination and stay with the facts. When the raids actually started with intensity, we were really well trained, and we were functioning.

We had control centers spread over the area, numberd one, two, three, and four. Those control centers had direct communication with each of the local control centers within each industry. The central control was in direct communication with the civil control for that region—not the district, the region.

Now all those communications were covered by messengers in case telephonic communication broke down.

Now there's a case of service which is very important and in which **you ought to be able to utilize the great resources of the Boy Scout movement as messengers.** Their particular training and their particular movement lends itself readily to such a service; and they'll never let you down. I can quote instance after instance of heroism under fire of boys sixteen years of age; yes, in some cases less, who've gone through terrible scenes to see that their message gets through.

So you rely perhaps more upon those than you do upon telephones, but telephones are very important; and it's amazing what a district can go through without breaking up the telephone system. Telephones come under our general post office services, and it's remarkable time and again how they function when you expect them to be disrupted every thirty seconds.

So that was the system of communications — telephone first; then messengers. Each control center was in touch by messenger and telephone service with its various wardens' posts; and each warden was in control of his sector. Each sector comprised a particular portion of a works or the vicinity of a works.

When the air raids grew in intensity, we found that that functioned perfectly. In the central and in each control room you had your district charted. In the central control room—we'll begin there—were all the points of importance, where equipment was, where wardens were, where all the various services were stationed throughout the entire district. They would be on call so that any part of that district which had suffered the greatest calamity was at liberty to draw upon the other.

After the first holocaust, it was found necessary that immediately any equipment could be freed from its existing preoccupation, it had to return at once to its station and report "Returned," so that the little flags which we moved about on the board could be replaced to show that equipment was ready to call upon, because often in that particular district a raid would take place and appear to be over; but what the planes had done was gone out to sea about sixty miles, switched off their motors, and glided in again to drop another lot of bombs when people were not expecting it and just recovering from the last lot.

Now the question of personnel. I don't mean the services personnel, but the ordinary personnel of an industry. Largely they agreed to do as the committee said. Very often time and again they were hurried into shelters, only to find that nothing happened. And then they came out again. Piece workers had lost quite a lot of money; so had time workers, but nevertheless it had to be instilled into them that sooner or later the real thing would happen. And they took it very well.

We practiced clearing. There was one shipyard—I seem to come back to shipyards, but that was my job—where we could clear every man. No matter where he was working on any ship, he would be under-cover in well under six minutes, and the average time taken was three minutes, from the going of the warning to everyone reported under cover.

Certain shelters had to be made. They were made, because it was found more difficult for men to get from one particular place to another; so we localized those. Now that is quick, very quick.

It is sometimes not quick enough. **But there is the unabridgable limit, and that can only come by intensive training,** because at certain times of the day, such as early morning where you begin work perhaps a half hour before it is daylight, and a certain measure of lighting is allowed, when the warning goes, that light goes out; and you have to find your way into those shelters in the pitch darkness. The maximum time was under six minutes, so you can see how much practice it took to perfect that.

As soon as the siren went, each warden went to his service station. First of all he blew his small siren whistle in case certain men had not heard the official siren, and he kept blowing that; and if anyone did not appear to know just precisely what to do, the warden stopped blowing and shouted to him directions, so there was no question at any time what anyone had to do.

> **That is part of the secret of Civil Defense as far as human actions are concerned—that your wardens are so competent they are like the Sergeant Major. He has always got an answer, and it's the right one.**

There are countless lives saved by these self-sacrificing men, these wardens. They are the key to the whole system, they are the link; and the work of those men is one that should go down in the annals of fame along with anyone else, because they are supposed to go to shelter when the siren sounds and be ready for duties after the raid; but I have never seen them go to shelter until every one of their flock was safely housed.

Now the question of volunteers. Some have to be officials, and some haven't to be officials. Some have to be the shepherds and some the sheep. Your textbook tells you that these people are to be selected from those most respected in their neighborhood.

Well now that doesn't always work. That is textbook theology. **You have to take whom you can get, and respected people are very seldom so forward that they'll press their claims.** And when you come to analyze who should be put in authority over you, you'll find not only slight shades of opinion, but very definite opposition about any particular individual.

Take everyone you can get who comes as officials, wardens, anyone who will accept responsibility. Everyone is not fitted for it, but accept them, because **time will weed them out.** Class distinctions, all these things which one is tempted at first to allow to interfere with these things, time weeds out; and the facts are that **you dare not discard anyone in case you are discarding a treasure.** And the need becomes so great that anyone who cares to volunteer, a place will be found and must be found for him or her.

Passing from the question of personnel, you go into the realm of plant protection. Now plant protection in Civil Defense is a subject of tremendous scope. Each building, each mechanism, has its own particular problem, and it's entirely outside my field to guide you in that protection, except such things with which I have been personally responsible; and they have been rather limited in view of being a control officer.

But there is one point in the protection of buildings which appears to me in the light of experience to be the most important. Protection against direct hit in Civil Defense is almost, I would say, an impossibility. In a military sense, yes; but in the civil sense almost an impossibility.

Nevertheless, there are two dangers, the incidence of which is greater than direct hits. One is blast, and the other is fire.

If you ask any fire chief of the City of London, England, what chemicals he'd use on such and such a type of fire, he'll answer, "For God's sake, give me hose and plenty of water," because in a great district that has been bombed and the water mains have burst, in a tidal area that has been bombed and the tide has gone out, and you have anywhere up to six, eight hundred or a thousand fires in your district, then I would be with him and say, "For God's sake, give me hose and plenty of water," because you run out of hose. It's burned as you are playing it on a fire.

You run out of water because the mains are gone, and every householder is frantically trying to get water; you go to dip your bucket in the tidal water, and the tide's gone out—you'd think it was deliberate, that the tide had waited until you got into that fix. The Nazis don't control the tides, we know, but you very often think they do.

So fire fighting, to me, appears to be largely a question of preparing water supplies locally wherever the need is apparent. That can be done with canvas reservoirs, concrete tanks, hundreds of them, buckets of water—never let them go down; never let them be atmospherically consumed or diminished. See that they are always filled. **A bucket of water can very often quench an incipient fire, where one hour later the whole fire-fighting equipment of an entire state cannot cope with it.** So, plenty of water and plenty of hose to use it.

In fire fighting, there is another very important implement which most people can make, although the official variety is by far the best, and that is these stirrup pumps.

The stirrup pump is little short of amazing, because schoolboys can handle it and very often do when they shouldn't. That stirrup pump has a nozzle which can through out a fine spray or a jet. I suppose you all know about it. You can get a description of it at any rate in textbooks. It is invaluable for upper stories particularly if incendiaries come through. They can be extinguished, or they can be sufficiently prevented from spreading so you don't have to call the regular fire brigade.

And I should say this, too, for those connected with Civil Defense, work on the principle from the start that you are not going to call the fire brigade.

Can you imagine a bomber traveling at two hundred miles an hour, carrying two thousand incendiaries, eight per cent of which in our country are effective? That means each bomber has a potentiality of one hundred sixty-five, not a potentiality; it's factual. And you might have one hundred fifty bombers, you don't know. The range of flying is daily increasing. Can you call upon the fire brigade? Make your own arrangements; forget they exist. They'll come along if they are free and if the need is there. You don't have to call upon them to come. Get on with your own fires.

Now blast is another question. Blast is the after-effect of the explosion of a bomb. It's not great in the light bombs, but in the heavy bombs, it is great. **The vacuum caused by that explosion is so great that it can create a wind traveling at two thousand miles an hour. Everything that gets in its path which is at all destructible is destroyed.**

One of the finest protections against blast is—let me try to give an example. We'll take the turbogenerator. Most of you are familiar with what that is. It's housed in a beautiful building, which is the envy of all the rest of the works; but the building really doesn't matter. That can function without the building.

So you have to decide in what building is equipment without which you cannot function, and you can build around that particular area a sandbag wall, or you can build a concrete wall, or a brick wall of certain dimensions. The dimensions again are all clearly shown in textbooks.

That is very effective against blasts; and if you can make that two layers deep, so much the better. The first layer may disappear, and the second layer will remain intact.

These are all simple things which you can do. In the case of big buildings, there is not a great deal you can do except from the point of view of fire fighting. From the point of view of blast, it's very difficult, but certain things can be done internally. Any architect could advise where the key points of a building of this nature are, and they can be supported with timber or steel, preferably timber on account of the steel shortage.

In times of war there is always a steel shortage. In this country I can imagine no shortage of timber. Any treasures that happen to exist in a building of this nature should be definitely stored away or efficiently sandbagged.

Against direct hit, I'm afraid there is little that can be done, but much can be saved by adequate attention to the protection of those things which are essential.

I would recommend that you pay little attention to things which are not essential, because the real essential in modern times is the saving of human life and only that which is necessitous in plant and equipment.

Now it may be that you want to ask some questions arising out of the general nature of the talk, but there is one thing I want to say to you in conclusion. It is my experience that it is too much to rely upon the fortitude of men, women, and children to fight air raids unaided and without skilled, trained, courageous leaders.

It is too much to expect of them, that great army of non-combatants who don't know what this is about, who don't want to know. They just want to be free from it; not unpatriotic people, simple, decent people. They will become associated with it if you can show the need, but even then they require skilled leaders to help them in times of great distress.

It's the measure of the practice which responsible people, that time and practice which they give to this job, which creates morale.

The speed and efficiency depend upon their practices, and in that way courage lies. If those people who volunteer for these services are truly conscious of the great necessities of their task, then in times of distress they will stand out in the tempest like a rock, a very firm rock, on which people can build and on which women and children can find security.

QUESTIONS

Q. Would Mr. Johnson care to describe the character of shelter provided, for instance, in the shipyard that he was familiar with?

A. We provided two types of shelter. One underground for those working on vessels or in plants on land; two, sandbag shelters on board ships afloat. The reasons are these: Sandbag shelters, which are rectangular bags on ships afloat, are placed on what is commonly known as the tanktop. That is down at the bottom of the holds of the ship. They are safe there from blast, and they are safe in those shelters from splinters.

When a bomb drops in water, the effect of its blast is to rise vertically rather than sideways, because the effects of a bomb always seek the path of least resistance, and in the ways of water, that is always vertical. That's how you get those high water spots after the explosion. And the ship being a buoyant object gives before the concussion, so we had to protect those men only from splinter.

In the landward side, that is in the shipyard precincts, we provided underground shelters; allocated fifty men per shelter. The top of the shelter was eighteen inches below the ground. They were arched in form, made of concrete, and the excavated earth placed on top of them. We would have liked to have gone deeper with these shelters, but a shipyard is on a water site, and to go deeper meant wet shelters, which are always a source of discomfort, even though your pumping system is perfect.

Q. Were these air raid areas determined by square foot of area or by the density of your manufacturing districts in the particular area? Was any definite rule laid down?

A. I kept mentioning natural areas. It's very hard to define. If you have an ammunitions works, for instance, making shells, that may very possibly be an area complete in itself, requiring all the services which are arranged actually for that plant itself without lining up with any others.

The areas naturally divide themselves. Rural districts can go to the limit of their means of communication. In another area, you have the question of proximity. For instance, you might have three firms altogether, each with dividing walls. They form a natural community, and you break down those dividing walls for quick intercourse by having sliding gates or something which can be cleared quickly. Does that answer your question?

Q. Yes. In other words, you base it entirely on natural conditions?

A. Natural conditions which are going to give the most effective form of defense.

Q. Do you know what was done for the school children? Were there shelters in every school, or did they collect from various schools?

A. That depended upon the locality of the school and the size of the school and the proximity of civil shelters. The basis was that if shelter could not be reached, I think the time was three minutes for the entire evacuation of the school to the shelter —I could not be sure about that—then the shelter was made within an area probably in the playing fields, as they did in many schools at home, so that they could be undercover clearly from the going of the siren to three minutes.

Q. Were they of the concrete type, eighteen inches under from the top?

A. They varied with the conditions of the ground, but, yes, they were always concrete; but the depth below the surface depended upon what sewerage there was. They went down as far as they could. In a big community there are all sorts of things under the ground, so it is not always easy to go straight down and put a shelter very deep. You have all sorts of telephone cables, conduits, water mains, gas mains—all those things to circumnavigate somehow. A perfectly efficient shelter can be eighteen inches below, except in a case of direct hit.

Q. Did you ever attempt to make basements or cellars into air raid shelters?

A. I have no experience of making basements into shelters so far as schools are concerned, where most shelters were always outside, and the secondary shelter arrangement inside, because of the dangers of collapse. There is quite a school of thought which says that basements can make good shelters. That has been proved in fact many, many times, particularly in the case of buildings with steel structure. So I wouldn't discountenance at all the question of cellars, except in the case of wooden buildings.

Q. Were these gas proof?

A. All shelters have gas prevention arrangements, but we have no means yet of saying that every shelter is gas proof. We have not had a gas attack yet.

Q. Have they built shelters in the schoolyards above ground where it was impossible on account of wet soil or something to go below ground?

A. They have had surface shelters, yes, and surface shelters have proved themselves to be very good if competently designed.

Q. They shouldn't hold more than perhaps thirty or fifty?

A. I would suggest fifty as a maximum, because when you get into the bigger shelters, a direct hit causes more damage.

Q. And if you build them out of a thirteen-inch brick wall, concrete slab five or six inches on top, with sandbags all over the whole business, and the entrance barricaded, you would regard that as a safe expedient?

A. I can't regard anything in this war as safe, but I can regard that as being humanly adequate.

Q. Is the concrete reinforced?

A. I would only suggest in any type of surface shelter you streamline it to the utmost.

HOSPITAL PROTECTION

By W. ROSS CAMERON, M. D., Medical Officer, Third Defense Region, U. S. Office of Civilian Defense

All buildings run the risk of damage in attack by air. Hospitals are no exception. In the past, these institutions frequently enjoyed almost complete immunity because of agreements between belligerents. In recent years, however, there is a tendency to ignore such agreements, and furthermore, it is often difficult, if not impossible, to distinguish even the most striking hospital markings in the very high altitudes from which bombs are usually dropped.

In the early days of the present conflict, particularly in Poland, these facts were immediately apparent. The chaos in hospitals defied description, and the urgent need of planning—and very careful planning—became all too obvious to those who would profit by the experience of others.

The protection of hospitals—both buildings and personnel—against enemy action, presents a number of problems peculiar to that type of structure. There are at least three important principles which should be emphasized:

1. At present little new construction need be undertaken.

In England, at least 250,000 additional beds were made available by the following procedures:

(a) Sending home all cases not in urgent need of hospital care.

(b) Using all available space in present structure.

(c) Making minor changes in construction.

(d) Utilizing adjoining buildings.

(e) Erecting huts and other temporary buildings on the hospital grounds.

By these expedients, the British have found it possible to avoid the construction of new hospitals although they have been repeatedly attacked and many casualities have occurred. It should be emphasized, however, that frequent changes in plans and considerable ingenuity have frequently been necessary.

2. Plans should be simple, elastic and practicable.

Those of us who have had experience in World War I, and in disasters, realize full well that plans should be simple in order to be understood. In emergencies people become confused and sometimes fail to follow even the simplest directions.

Plans should be elastic so that they may be applied with equal ease to small and large institutions in small or large communities, under many varying conditions.

Plans should be practicable in order to appeal to one's common sense and, once inaugurated, they usually proceed on their own momentum.

3. Each institution should be organized so that it may operate as an independent unit, if that should become necessary.

This may usually be accomplished by providing an alternative for every type of service. Each institution should develop its own program for evacuation so that this may be effected with the minimum of assistance from outside sources.

General Administration

Hospital administrators should plan systematically to coordinate their efforts with all community organizations that may be directly or indirectly concerned with hospital affairs.

For example, the Chief of Emergency Medical Service should be frequently consulted, as well as his Advisory Council, or other planning boards. There might well be a constant exchange of views, a central supply depot, and an arrangement for exchange of transportation facilities and hospital personnel.

It seems important that each large hospital appoint a liaison officer who should be thoroughly familiar with all other allied organizations so that he should be in a position to cut "red tape" during emergencies.

Through the press, radio and other methods of publicity, the hospital administrator should inform the community of the emergency plans. This will prevent confusion and assist in making the best possible use of the hospital. It will also serve to reassure the public that every reasonable effort is being made to render competent service in the event of disaster.

The Cost

There seems to be little indication that the Federal Government is planning to make great expenditures for hospital protection at this time. A limited amount of money may be appropriated for the purchase of equipment.

It is suggested that the following procedures might be adopted:

1. Estimates might be obtained of costs of structural changes that would make it possible to increase the number of beds.
2. The strictest economy should be exercised. A special effort should be made to recondition all salvagable equipment that may be in storage.
3. Reserve supplies of certain essentials should be accumulated whenever possible.
4. Estimates should be made of the number of additional personnel which might be needed.

These suggestions should be discussed with the hospital board of trustees or managers and, whenever possible, means should be devised to execute them.

Hospital Protection may be divided into two parts:

1. Protection of the buildings.
2. Organization and protection of personnel.

Protection of Buildings

A survey of facilities should be made without delay, including a census of beds and all other equipment. A consideration of the extent to which kitchen facilities may be expanded is of great importance. An estimate should be made of the number of beds that may be added in classrooms, solaria and other available space.

A hospital should not be encouraged to participate extensively in this program if it falls in one or the other of the following categories:

1. If it is located in a "dangerous" locality, that is (a) in close proximity to a probable target, particularly a large defense industry, or (b) if it is situated in a congested urban area.
2. If the building is large and old, and not of fire-proof construction.
3. If the institution includes 50 beds or less and is located in a large city. Hospitals of this size in rural areas should be excepted. Many of the latter may be extremely useful.

In the event of enemy action or disaster, particular attention should be given to the distribution of casualties throughout the hospital. Wards should not be overcrowded so that physicians and nurses will be so fully occupied that they cannot give the proper amount of attention to each case.

There are at least three types of bombs—gas, incendiary, and high explosive.

It has not been found possible to construct hospitals to withstand direct hits by high explosive bombs. Brick buildings on steel frames, or with concrete columns, are least likely to be seriously damaged.

Buildings with walls of brick alone, concrete blocks, or wood, cannot usually be made even reasonably safe without extensive alterations. It would usually be better to abandon such a building in case of an air attack.

If major changes are not feasible, and this is frequently the case, the following procedures should be adopted:

(a) Essential services should be concentrated on the lower floors, since direct hits are least likely to penetrate to that level.

The lower floors may be protected by reinforcing brick walls with masonry or sand bags. The latter are useless unless properly arranged in walls at least five feet in height (ten feet being the maximum), six feet in depth at the base, tapering to two and one-half to three feet, and placed two or three feet from the outside wall.

(b) Windows: The only really safe method of protecting windows is to remove the glass.

Cubicle glass walls, shelves, and table tops should be replaced. Large sheets of plate glass should be removed since there is no satisfactory method of protecting them. In their place, small panes should be used. Skylights and domes should be boarded up and reenforced by fire-proof timber.

To prevent splintering of glass, the following may be considered:

1. Procure "non-shatterable" glass.
2. Use screens composed of close-mesh wire netting.
3. Criss-cross the panes with paper, tape, or gauze.
4. Cover with cellophane or x-ray films which have been stripped of their emulsion.

(c) Fire Protection—Each institution should select its own fire spotters and fire fighters. These should augment the local fire fighting forces and not supplant them.

Inflammable material should be removed from attics. X-ray films should be stored in a safe place.

Since the roof and attic are the most frequent targets of incendiary bombs, these should be rendered as fire-proof as possible. Fire-proof paint, asbestos, sheeting, or even concrete may be used.

Trained watchers should be assigned to roof tops in case of threatened attacks by air.

Other aids to fire protection include:

1. Automatic sprinkler systems.
2. Portable extinguishers.
3. Stirrup pumps which emit a fine spray, used to control incendiary bombs.
4. Pails filled with sand, weighing a maximum of ten pounds, together with a shovel for each pail.

Fire drills should be conducted at fairly frequent intervals.

The following arrangements are suggested to permit a more rapid exit of personnel:

1. Convalescent and ambulatory patients should be located on the upper floors. They should be instructed to leave the building **first.**

2. The seriously ill patients should occupy lower floors and leave the building **last.**
3. Ambulatory cases, orderlies, emergency helpers, nurses, and others should be assigned to remove the most seriously ill patients.

(d) Shelters—No shelters are absolutely safe from a direct hit unless they are 100 feet underground, or specially constructed. Such shelters are rarely to be found.

In their absence, basements and cellars afford a fair degree of protection against anything but direct hits. It is essential that two or more exits be provided, that proper ventilation be installed and that reserve supplies of beds, blankets, drugs and food be kept in storage in all shelters.

(e) Camouflage—Existing buildings should be camouflaged as much as possible in accordance with the directions of competent authorities.

(f) New Construction—Newly constructed hospitals should not be placed in the open spaces as has been done with so many recently erected industrial plants.

New hospitals should be placed in carefully chosen sheltered localities, and it would seem wise to install all recommended protective procedures.

(g) Blackouts—The process of excluding light from hospitals is much the same as for other buildings.

Skylights, domes, and transoms should receive particular attention. All unnecessary lights should be eliminated and the candle power of others reduced. Lights above doors should be protected with great care. Operating rooms, which are usually highly illuminated and located on the top floor, require particular attention.

(h) Utilities—Maps should be prepared of the distribution of all essential services.

It should be emphasized that as a matter of principle these services should be duplicated wherever possible.

More than one telephone cable should be installed and each should enter the building from opposite directions. There should be a direct line to the air-raid warden's post.

Lines should be reserved for outgoing calls since, during an emergency, incoming calls might monopolize all lines. In England, it has sometimes been found advisable during an attack to cut off all telephone communications, except to hospitals and other essential services.

To relieve the telephone service in summoning auxiliary personnel, it may be arranged in advance that the operator will notify but two persons. Each of these two persons will call two others, and each of these four will call two others, and so on.

Messenger service provided by boy and girl scouts and volunteer workers, has also been found very useful in relieving switchboard congestion.

Lighting—If possible, an auxiliary lighting plant should be procured. In addition, each employe might be furnished with a flashlight. Candles, being fire hazards, should not be used except as a last resort.

Water Supply—Water supply lines should be duplicated, entering the building from opposite directions. A reserve well supply is desirable. Storage of water in volumes sufficient to supply even a small institution is usually impracticable. Paper cups and plates may be kept on hand, and mineral and distilled water should be in storage.

Heating System—If the heating plant should be destroyed, the personnel may wear additional clothing. As a rule, however, it is usually necessary to evacuate the institution in cold weather.

Sewerage System—If there is a break in the sewage disposal system, pumps may be used to pump out flooded engine-rooms and basements. Such a condition is so menacing, however, that evacuation is the recommended procedure.

Garbage—Each hospital should maintain an emergency incinerator.

Laundry—Additional personnel and equipment should be provided.

Operating Rooms—These should be located in the basement or near the admitting rooms. Fracture and plaster tables are also essential in this locality.

Additional Supplies—Reserve supplies of the following equipment should be procured: beds, blankets, stretchers, fuel, drugs, biologicals, splints, transfusion facilities, and other essentials.

Augmentation and Identification of Personnel

Arrangements should be made in advance for the exchange of personnel with other hospitals, and for the employment of additional individuals and procurement of volunteers.

Each employe should be provided with identification badges or papers. All should be inoculated against typhoid and vaccinated against smallpox.

Transportation

Few hospitals maintain an ambulance service. Detailed plans should be made for the formation in each community of a well organized ambulance service under the direction of a Transportation Officer. The latter should be carefully selected. He should be familiar at all times with the distribution of patients in the hospitals in his area, so that he may direct ambulances to those institutions in which beds are available.

Miscellaneous

Principal conditions resulting from attack by air include: burns, crushing injuries, fractures, shock, hæmorrhage and, possibly, gas casualties. Special preparation should be made for the treatment of each type of case.

Air-raid Warning System—Each employe should be made thoroughly familiar with the various signals of attack, not only those that are received from Control Centers, but those that may be adopted by a particular area or institution.

Extra Clothing—Many air-raid casualties have their clothing so badly soiled or torn that it can no longer be worn. An extra supply should be available, particularly for destitute persons.

Identification of Casualties—It is important that casualties be identified with the least possible delay.

Radium—If this substance is utilized, it should be stored in the safest possible place. It might well happen that a quantity of radium, lost during an air-raid, would prove quite as menacing to the community as an unexploded bomb.

In conclusion, the necessity for team work in every hospital is stressed. Not very much is gained if there is a well organized admitting department when the operating room teams are inadequate, or there is serious congestion or confusion in other departments of the hospital. Only by careful planning and united action may each hospital serve the community with the utmost efficiency.

INDUSTRY'S RESPONSIBILITY

By COLONEL CLIFTON LISLE, Acting Regional Director, U. S. Office of Civilian Defense

Gentlemen, I'll be very brief, because we have more important work to cover, but while I was listening to the speeches this morning, two facts came into my mind, which I think should be brought to your attention.

Each speaker stressed indirectly the fact that the key to this whole matter of protection obviously rests on ourselves and on the units concerned. What I want to tell you is this: In the Third Corps Area, which includes, as Dr. Marts has said, Pennsylvania, Maryland, Virginia, and the District of Columbia, we have had, for the last eight or ten months, applications constantly coming in, asking what military assistance can be given to individual projects, or plants, or works in the event of an emergency or prior to it.

> **The answer is that no protection of the passive sort whatsoever can be given, because there are not enough people to go around.**

The number of requests for troop protection to be used not as troops, but as police and fire guard primarily, have recently been added, and it might surprise some of you to know that the total came to somewhat over 100,000 troops.

I think you can see if in three states every request were granted what would happen to the armed forces. I mention that, for I think it is important.

I find in going about the region that **people think when the time really comes the Government will step in and remove the danger of sabotage by assigning just a few troops to take care of an important dam or an important installation of one kind or another; but that cannot and will not be done,** unless the entire policy has been changed, because the number of applications, all of priority importance, are too great. The number is too great for us to attempt that.

I think that will perhaps lend a basis for questioning as this school goes on, because I know that many, basing their experience upon the past war, will say, "Well, certain phases will be covered by Federal forces." There are not enough Federal forces and will not be under the present policy to divide them in that fashion, so that everything that has to do with Civilian Defense will have to be done by the people concerned.

> **The Corps Area Commander has asked me to stress that again and again, because it is building everything upon a false foundation if you assume that you will not have to take up police protection of your own plant, or if you assume that in the civilian way, as we stressed this morning, you can call upon the local fire department to put out a fire.**

It is exactly the same thing if your plant catches on fire due to incendiary bombing, and we have a thousand fires going here in some district of Philadelphia or other metropolitan areas. That fire or fires must be put out by the training that you evolve from what information and instruction you can get from schools of this sort. And the far more intimate danger of internal sabotage, or destruction, or fire, or anything else in your plant will also have to be handled by your own protective measures.

I think that that is worth bringing to your attention, because so many people tell me when I discuss this with them that they will take care of certain phases, but they are quite sure military police battalions will be sent in to relieve them. The experience abroad, on which this new plan of ours is based, proved that you cannot do that.

> **The magnitude of the emergency, if it comes, will be so great that everybody in the armed forces will have to be used in the active defense, and every man and woman, organized or not, will have to play his part, or cause suffering and death, in the passive or civilian defense.**

I do hope you will all realize that, because the responsibility is passed entirely to you for the protection of your own plants, your own buildings, your own communities. The Government will do what it can to furnish material, if that is necessary; but they cannot furnish personnel. You must train your own.

It is just as apt and more apt to have internal trouble through strike and sabotage, timed and coordinated.

It is possible to have token bombing on a surprisingly large scale right over Philadelphia at any time. That is a known fact to the War Department. These are no secrets that I am betraying to you.

There are plenty of planes that can reach Philadelphia and have a six hundred mile cruising range in our area and return to the Continent of Europe, and bring not their full complement of two thousand incendiary bombs, but bring sufficient fuel for a return voyage, plus six hundred miles, and one thousand incendiary bombs, which would give you, on the percentage we were told this morning, only one hundred fires per plane.

That would allow, of course, the rest of the bombs to fall in the streets and not go off; but **if you have one hundred fires per plane, which is, if a flyer flew in a straight line, every fifty yards for considerably over a mile and a half, I think you will see you have a proposition.**

Do consider the necessity of everybody in this room who represents any plant or any building making plans to protect the property himself. There will be no outside aid. I cannot stress and restress that too strongly, because hitherto in our history everything has been based on going to somebody who had a fire engine or a police force or something to help us. That is no longer true. The protection must come within the school, the hospital, the manufacturing plant, the shipyard, the lumberyard, whatever it happens to be.

I think if we base our discussions in these meetings on that foundation and ask questions of the instructors on that basis, it will perhaps drive home even to ourselves the individual responsibility that we must share if this protection is to be given us.

AIR RAID WARNINGS

By ALAN CRAWFORD, Bell Telephone Co.

It is obvious to all of us that the first attack against this Country would be directed by sabotage or air bombing, or both, against industrial plants and transportation systems with a consequent danger to the civilian population.

The Army plays a dual role, both preventing any such occurrence and, at the same time, warning the civilian organizations of danger in case some enemy planes break through this protective cordon.

A permanent system of Air Defense has been established along the coastal areas. In the northeast section of the United States we are in the First Air Force. This First Air Force has been divided into strategic areas with an information center located in each subarea.

For example, the information center in Philadelphia includes the eastern half of Pennsylvania, the southern half of New Jersey, all of Delaware and Maryland and parts of Virginia and West Virginia. An information center is further sub-divided into filter board areas. Thus the Philadelphia Information Center is composed of a filter board area including the section around Philadelphia to the coast, one in Harrsbiurg for that area, and one in Baltimore for the southern area.

(The information center in Buffalo is composed of two filter board areas—the far western section of New York surrounding Buffalo, and the western portion of Pennsylvania, plus a strip of Ohio and West Virginia, surrounding Pittsburgh.)

These filter board locations, built by the Army, receive information on aerial activity at first hand from ground observation posts. Mistaken information is "filtered out"; pertinent information is evaluated and in turn passed by telephone to the information center.

Two sources of information on aerial activity are available—the Army locator system and ground observation posts. The latter have been established throughout the State five or six miles apart, manned by civilian volunteers. Approximately 900 have already been organized in Pennsylvania.

These posts report information on aerial activity by telephone to their respective filter board locations. Even before enemy bombers could reach the coast the locator system will have spotted their position and reported it to ther information center.

An information center is primarily a large scale horizontal map board of the whole area on which is plotted by arrows the progress of a flight of planes.

The Army locator system permits plotting before they reach the coast line, and as they swing inland the ground observers, minute by minute, will call in their reports giving the type, number, height and direction of the invaders. Flights may split up and each element head for one objective. This all appears before your eyes as a plot on the map board.

Then follows a swift succession of events. The Controller, with his Pursuit and Radio officers sitting on a balcony overlooking the map board, assigns one or more pursuit squadrons to intercept the enemy. While this is taking place an Interceptor Officer, who will handle the attack, is plotting on another smaller scale map the best course for engaging the enemy. In constant radio contact with the fighting planes in the air, he directs the attack from the ground.

Also on the balcony with the Army experts is the Civil Air Raid Warning Officer. He watches the progress of the flight on the map board and it is his duty to send warnings to threatened areas so that proper measures may be taken to protect industries and civilian population.

At present the Eastern portion of Pennsylvania has been divided into 33 District Warning Center areas with the warning center located in the principal town or city, usually coinciding with the toll circuit layout of the Telephone Company in order to facilitate the dispatching of warnings by telephone.

Nineteen of these warning centers have been organized and were used during the recent Army test which covered the area east of a line drawn through Scranton and Harrisburg. Six districts were warned by the Civil Air Raid Warning Officer in Philadelphia, four by the Officer in New York and nine by the Officer in Harrisburg. The list of organized warning districts is as follows:

From Philadelphia:

Philadelphia, Doylestown, Norristown, West Chester, Allentown, Easton.

From New York:

Scranton, Wilkes-Barre, Stroudsburg, Honesdale.

From Harrisburg:

Lancaster, Pottsville, Mauch Chunk, Hazleton, Gettysburg, Lebanon, York, Reading, Harrisburg.

The Pittsburgh area warning centers have not yet been selected. The Army and Civil Defense authorities collaborate in determining the location.

(The western portion of the State will probably be divided into 20 or more areas, with the warning center located in the principal city in each county.)

In each location an Air Raid Warden is appointed and given instructions regarding the necessary organization and duties to be performed upon receipt of warnings telephoned to their headquarters. The air raid warnings issued by the Civil Air Raid Warning official are of four types:

Yellow, indicating the possibility of a raid on a district.

Blue, indicating the probability of a raid.

Red, indicating that an attack is imminent.

White, indicating all clear.

In order to determine the degree of warning to issue at the proper time a special map of the area is provided with each warning district outlined thereon. By plotting the spearhead of the particular flight, the Civil Air Raid Warning official can determine which area may be a possible target.

From a template marked into three concentric curves, colored yellow, blue and red, based on the speed of modern bombers, he is able to judge when to issue a yellow, blue and red warning. For present tactical purposes—with a possible speed of 300 miles an hour—a yellow warning is sent to a warning center 100 miles from the spearhead of the flight, thus giving 20 minutes notice of the possibility of a raid; a blue warning giving 12 minutes notice, and a red giving 5 minutes notice. He must judge from the general direction of the flight and his knowledge of the area what might be a likely target.

To issue these warnings the Civil Air Raid Warning official is provided with a telephone terminating on the headset of the Operator of the special switchboard located at the Army filter board or information center. This switchboard has four circuits for each warning district, colored yellow, blue, red and white. Selecting a cord which terminates in the nearest telephone toll office, the Operator will plug in to the proper colored jack as directed by the Civil Air Raid Warning official.

As an example: She will ask the Toll Operator for Allentown. The Toll Operator will connect over regular telephone circuits to the Allentown Toll Operator who will receive an order "Allentown Blue". This Operator has four circuits colored as above which terminate at the location selected as the headquarters for the District Warning Center. She plugs in to the blue circuit and rings.

At the headquarters is provided a set of four colored lamps and a telephone instrument with four colored buttons. The Air Raid Warden, upon hearing the telephone ring and seeing the blue light burning, will depress the blue button and answer as "Allentown Blue". The Operator back at the switchboard in the information center or filter board confirms this report and disconnects, leaving a plug in her blue circuit marked "Allentown". This serves as a reminder to her and also lights a blue lamp on the map used by the Civil Air Raid Warning official.

This equipment as described at the Army location and at each District Warning Center, together with all telephone calls, is paid for by the Army.

The warnings have now reached the locations where the Civil Defense organizations take over the responsibility.

It is obvious that each warning district must be completely organized and trained to disseminate the warnings to the proper points within their district according to a prearranged plan. Only after thorough study and complete cooperation and understanding of all elements involved can a practicable scheme be developed.

Industrial and commercial plants, of course, present problems peculiar to their activities and design which will require individual solution. Nevertheless, **their air raid precaution system should be organized along lines parallel and similar to those of the district warning center.**

Upon receipt of a warning the district warning center must be prepared to send the proper information to subareas, called Report Centers, located in distant towns or cities and also to report centers and other agencies, such as fire, police, etc., and large vital industries within its own center.

Thus, a warning center must have a communications system. In the simplest case, one or more exchange lines, graduating according to needs into a more or less elaborate system of private lines or signaling devices.

Upon receipt of a yellow warning the warning center will disseminate this information to the locations in accordance with a predetermined list. A telephone call or signal warning to the various city agencies and vital industries will permit them to unobtrusively start preparations.

This call or signal, in the case of industries, would go to the Air Raid Warden or Plant Defense Coordinator. **He would inform his air raid precaution personnel through the company private branch exchange and, without distracting the working group, the various pre-arranged preliminary steps would be taken.**

Upon receipt of a blue warning further measures would be taken, such as sending all organized fire, maintenance, or other designated employees to their posts. This would probably be done without disturbing production, although some types of industry might start evacuation and shut down at this warning.

When a red warning is received the complete precaution and air defense plan would be activated, sirens or signals in every building and on each floor sounded and all extreme measures taken.

The air raid precaution personnel in any industry would be broken down into four main divisions—**fire, police, medical and maintenance.** It would therefore be necessary to set up a local report center within the plant, with sub-centers for each division, and with a system of communication between these key positions.

In plants covering a large acreage a study might indicate the necessity of establishing further sub-centers with each of the four divisions functioning for that location. A study of the present communications system is necessary since congestion of calls or destruction of important lines of communication might make inactive the whole protective system.

It would be reasonable to give some consideration to setting up within your plant, code calling, paging, flashing lights, and similar plans, either as substitutes or to relieve the burden on the regular telephone system.

Additional telephones or signaling devices may be required in many spots. For Example: if roof watchers are used, as is now being done to a great extent in England, they must be able to be in instant communication with the Chief Warden.

It would appear, therefore, that in planning any program for defense of your plant, consideration should be given at the same time to the communication problem.

Thus we see that the Army has established an elaborate defense system which furnishes all necessary information to strategic locations for civil defense groups. It is wholly our responsibility to carry on from this point.

QUESTIONS

Q. Mr. Crawford spoke of the Army Locator System. I want to know how far they cover the scene, if you know?

A. I will not answer that, because the Army does not like descriptions of that Locator System given out, unless Colonel Lisle here will, and I'm darn sure he won't.

Q. You talk about so many minutes and different colored lights. We are on the Atlantic Seaboard, and it will take them only a few minutes to get in if they are spotted by the ground observation post.

A. Your question is if the Army Locator System picks them up out at sea, how do we get them?

Q. No, I just want to know if they did?

A. They do.

Q. You spoke of so many minutes between lights. They could come in from the Atlantic Seaboard, and we on the Delaware River wouldn't have twenty minutes.

A. If you recall, I said the Army Locator System permitted the plot of that flight to appear before your eyes on the mapboard, and as the spearhead of the flight comes in, to appear on the mapboard, which has the Atlantic Ocean on it, so the first indication of a plot of planes is way out in the ocean.

Q. I just wanted to be sure it was out there in sufficient time.

A. It is.

Q. Mr. Crawford, is there a chart made of that organization so that we might obtain it for instruction classes, that is, coming into your central control board?

DR. MARTS: Yes, there is. O. C. D. has issued a booklet on that subject, and if you wish a copy, ask us at the State Council of Defense. We will be glad to send it to you. I might also say the O. C. D., that is the Office of Civilian Defense, Mayor LaGuardia's office, has also issued a very useful little air raid warden handbook, and we will have some of these handbooks here Saturday morning, I trust, so each of you may have a copy. That describes again some of the things Mr. Crawford has told you.

Q. Have you any information as to how long this system takes to flash a warning ahead, say, for instance, to Allentown?

DR. MARTS: I'll give you the answer in Allentown as far as the Council of Defense is concerned. When that light appeared on the black box in Allentown, it took three minutes and twenty-six seconds to warn the entire warning list in Lehigh County. That was by test back on October 16.

MR. CRAWFORD: Your question is how long from the time a flight is plotted on the mapboard until the call gets to Allentown? On the average, I think it was thirty-six seconds; some of them longer; some of them shorter.

At the present time, they are talking about a twenty-minute leeway on the yellow warning, and the Army authorities feel that is too long. They are probably going to cut that down. You are not going to get much warning if the Army has its way in cutting the twenty minutes down to fifteen.

SHOCK EFFECT ON PLANT STRUCTURES

By PROFESSOR F. P. WITMER

Director of the Civil Engineering Dept.,
University of Pennsylvania

So far as the speaker is aware, the only effects of shock which have been considered up to the present time in the design of building structures in the United States have been those due to the wind force of hurricanes or tornadoes and to earthquake.

All structures of importance, however, are designed to resist wind forces of intensities which are the maximum that may reasonably be expected with due regard for the location and environment of the structure.

Earthquake action is quite generally taken into account in the design of buildings located in zones subject to such phenomena. This is particularly true of California and certain other western states. Some of our most notable bridges, for example that over Carquinez Strait and the Oakland Bay Bridge, both in the San Francisco area, were designed with special consideration of earthquake shock. This procedure has not been followed very generally in the east, particularly in the neighborhood of Philadelphia.

It is necessary to give some consideration to the nature of the effects produced by various kinds of shock.

The effects of extremely high winds and of earthquake action are very different from each other, and also from shock due to explosion, but to a certain extent knowledge gained

from a study of the former two phenomena may guide the design of structures which may be called upon to withstand attack by bombing.

Some years ago an exceptionally violent hurricane struck Florida and caused much destruction. Steel frame buildings generally stood up well, but in certain cases failure occurred. Subsequent study showed that the weakness was not in the size of the members, but rather in the details of their connections to each other.

The factor of safety used in designing is such that a considerable overload may occur, without stressing members to the failing point. **But unless the detail of the connections of beams to columns is carefully made in accordance with correct mechanical principles, the connection may fail,** and this is what actually happened in the cases in question.

The general principle was clearly established that the most essential requirement is efficient details for connections, and this principle holds good for a structure subjected to any unusually heavy forces suddenly applied, such as may come from wind, earthquake or explosion.

It is a well-known mechanical principle that the effect upon a structure of a force suddenly applied is much greater than that of the same force applied gradually. If in addition there is impact, that is, a forcible blow which must be resisted practically instantaneously, the effect is still further enormously increased.

In the case of wind force, the impact element is missing, but the effect of sudden application may be felt if the velocity, and therefore the wind pressure, is exceedingly high.

The pressure due to wind varies as the square of the velocity. For a velocity of 50 miles per hour, the pressure is about 8 to 10 lb. per sq. ft., whereas for a velocity of 100 miles per hour it is about 35 lb. per sq. ft. Hurricane winds may attain a much higher velocity than this, with correspondingly greater wind pressures.

These forces would make themselves felt throughout the entire structure, but destruction of a steel or re-inforced concrete building well designed with carefully calculated details at joint connections seldom occurs from the action of wind.

The recent destruction of the Tacoma Narrows Suspension Bridge across Puget Sound, by a moderate wind, which had a velocity of less than 50 miles per hour, was not due to overstress resulting from wind pressure, but to the dynamic action caused by the nature of the design, through which fatal undulations were induced by a wind whose velocity happened to bear a critical relation to the vibration period of the bridge.

A similar effect may sometimes be produced in the case of a building acted upon by earthquake force.

With earthquake action, the character of the force and its manner of application are quite different from wind force. An earthquake shock takes the form of a horizontal acceleration applied at the foundations of a building. This induces a force whose magnitude depends upon the mass and the dynamic vibratory constants of the building. This force is oscillatory in character, tending to move the bottom of the columns or walls alternately in two opposite directions.

The period of oscillation may vary from a fraction of a second to several seconds. The most destructive period is between one and two seconds. The duration of the periodic oscillations may be several minutes, but the greatest damage is generally realized during the first minute. The amplitude of motion also is a very important element. In cases actually measured, this varies from about ½ inch to 2 inches or more.

While the greatest destruction usually occurs with a period of about one second, the effect is very greatly dependent upon a synchronism between this period and the dynamic vibration period of the structure.

The force applied at the base of the columns tends to shake the entire building back and forth with considerable speed and violence, and this racking action is the cause of the greatest destruction. Loose parts are shaken down, walls and partitions shattered, and, of course, water systems, sewerage systems, gas and electrical installations are disrupted, with consequent fire and other disastrous results.

If the structure has a frame of steel or reinforced concrete well knit together and with efficient connections, it will generally withstand the shock.

It is desirable that it be not too rigid, but made with considerable flexibility, so that it may distort a reasonable amount by the developmesnt of bending stresses in the members. Connections of columns and girders should be rigid in construction, but relatively small in dimensions, to allow sufficiently free horizontal sway.

Rigid diagonal bracing between columns is not generally best. Beams resting on the top of columns or walls will obviously be most vulnerable. Connections for a steel frame should be carefully designed and of either riveted or welded type.

The effect of explosion is quite different from that of either wind or earthquake. It combines sudden application with maximum impact effect. The oscillatory action of the earthquake with its accompanying racking effect is, however, absent. **The action is almost instantaneous, producing exceedingly high forces by reason of the excessive kinetic energy involved, and the destructive consequences are therefore enormous.**

A recent comment by a British consulting engineer stresses the similarity in the most effective type of design for a structure subjected to earthquake and one subjected to the lateral force of explosion; but points out that in the case of earthquake the forces act below or at the ground level, whereas with a bomb they may act at any floor where the explosion happens to occur.

Three types of destructive explosion may be recognized as related to the present emergency:

(1) **An aerial bomb falling through a great distance before exploding.**

(2) **An explosion in the interior of a building.**

(3) **An exterior explosion, taking place at approximately the ground level of the structure.**

The effects of these upon the building will be somewhat different from each other. The aerial bomb will usually strike the roof and pass through several floors, finally exploding at or near the bottom of its fall. However, as the bomb is dropped from a plane usually traveling at high speed, its path will not necessarily be vertical, but may be inclined due to the onward motion originally imparted to the bomb by the plane, and it may therefore strike a wall of the building, first shattering it, and then passing on through floors to the basement.

British engineers state that a 500 lb. bomb can perforate a roof and five floors of reinforced concrete 6 inches thick.

With the thinner floors of cinder concrete and the light weight partition walls so common in our building contsruction, **it is probable that such a bomb might pass through as many as ten floors, and probably reach the basement before exploding.**

The first destructive action is due to the excessive kinetic energy resulting from the great height through which the missile has fallen. It is practically impossible to protect a building from this force. A bomb weighing 500 lb. and dropped from a plane 15,000 ft. high would possess energy sufficient to penetrate a concrete slab perhaps 15 ft. thick, or a slab of steel possibly 30 inches thick.

Obviously no such dimensions would be practicable in the design of roof or floors, and, equally obviously, no beams or girders could be made to withstand such forces. This action, moreover, is not inclusive of the ultimate explosive action, which sets free tremendous forces in all directions, destroying walls, columns, floors, machinery, and everything at close distance.

British experience shows that frequently the vertical effects of explosion are by no means inconsiderable, heavy fragments being often thrown as high as the tenth floor.

But there is no doubt that the lateral forces of the explosion are the most destructive. Fortunately the effect of explosion diminishes rapidly with increasing distance from the centre of action.

British authorities, as a result of their experience, have recommended the following thickness of various structural materials which would afford protection against fragments from an exploding 500 lb. bomb, at a distance of 50 ft.—

Steel plates, 1½ inches thick
Brick or concrete masonry, 12 inches to 15 inches thick
Earth, sand, or broken stone, 24 inches to 30 inches thick

It is also said that a 40 inch thickness of wool will afford a similar degree of protection. This raises the question whether bales of cotton might not also be effective.

It is manifestly impossible to arrange the interior of a building to provide such protection against an aerial bomb, because the point of entrance of the bomb is unknown. A protecting wall of proper thickness might be constructed around a power installation or other vital part, and afford some relief against a bomb falling outside this wall.

But it would appear that a bomb dropped from above and penetrating the roof would generally have to be permitted to perform its full destructive work, although this might be confined within some limited area.

Everything in this area would probably be annihilated, and the destruction of neighboring columns or walls might cause large adjoining sections of the structure to collapse. A building covering a large superficial area would probably be spared destruction for such portions as are located sufficiently distant from the point of explosion.

An interior explosion might result from accident, or from an act of sabotage. Its effect would be similar to the explosive effect of the aerial bomb, but without the damage due to the energy of the falling body. The roof and upper floors might be spared, unless supporting columns and walls were blown out.

> **The only way to guard against such an event would be by scrupulously alert oversight of plant operations to avoid accident, and rigid policing to prevent intentional malicious damage.**

Exterior explosion may result from an aerial bomb or a placed bomb. In both cases the effect upon the building would be similar, but the part first struck would be the exterior walls, and interior parts reasonably distant from these might be spared.

Outer walls may be made with sufficient thickness to withstand the shock, and in this case shelter zones of considerable proportions may be constructed within the building, to afford protection against exterior explosion. Such construction calls for splinter-proof and blast-proof outer walls for the first three or four stories above the street level.

Also, it is possible to make a basement or sub-basement shelter zone by providing a covering slab of concrete of sufficient thickness, together with protective walls, to resist ground shock from a bomb exploding after penetrating the earth in the vicinity of the building. Such a bomb will hollow out a crater, and heavy forces from the explosion will be transmitted in all directions through the earth, but they will lose effectiveness at a comparatively short distance from the explosion, and such walls, with a safely constructed roof, will afford protection to personnel.

Such underground shelters, however, are in danger of flooding from broken water mains and from gas pockets resulting from disrupted gas mains, and these matters must be carefully considered.

In general, wall-bearing construction is worthless in resisting explosive or earthquake shock. Construction should be well-knit riveted or welded steel frames or reinforced concrete.

British experience has demonstrated that such types of construction show superior resistance to all sorts of bomb effects. One modern steel skeleton building is described which, with its exterior fairly intact, stands between badly damaged old houses. Inside, its nine stories are burned out, but it has kept its shape and will be easily and quickly repaired.

Another feature strongly emphasized by British commentators is the importance of fire-proofing the steel-work. This is necessary as protection against incendiary bombs. **Columns, girders, and floors should be given a high degree of heat resistance.**

Basement walls should be sufficiently heavy to withstand the forces transmitted through the earth from a nearby explosion. Naturally portions of a building in interior bays are safer against exterior explosion than those nearer the outer walls.

In an existing structure, it is possible to reconstruct interior partitions, making them of splinter-proof construction, of either brick or 12 inch thick reinforced concrete. It is also possible advantageously to reinforce walls around interior fire stairways, to enable safe exit in case of attack.

For new construction, heavy partitions should be used and floor slabs equivalent to 6 inches of reinforced concrete are recommended, so that there may be a fair chance that a falling bomb may be checked before reaching the ground level and thus have its explosive destruction reduced to a minimum.

Naturally if the explosion can be made to occur in an upper floor, there is a greater chance that the lower portion of the building may be in a measure saved.

In the case of an existing building not designed to be bomb-resistant, protective walls may be built at some distance outside the structure, and these would possibly save serious damage if the explosion were distant say 40 or 50 ft, from these walls. These should be extended down deeply enough to afford protection against the forces transmitted through the earth.

It is, of course, futile to consider in great detail the method of designing a structure to withstand these emergency shocks, except in the case of new construction.

As previously stated, few buildings in this vicinity have been designed or constructed to resist any of the foregoing forces, excepting that from wind, and therefore, save for some protective construction, such as has been suggested, it is difficult to accomplish much in the way of protection against damage resulting from hostile attack.

Other serious phases of damage besides that to structure, machinery and other equipment, would be in the form of fire or disruption of water, gas or electric installations. Fire-fighting organization is of vital importance, as well as the personnel and facilities required for speedy repairs to electric equipment, damage to which may, of course, contribute indirectly to the danger of fire or personal injury.

The hazard of broken glass is another serious item in any kind of explosion. It can be lessened by an increased use of non-shatterable glass—such as wire glass or laminated safety glass.

If not already constructed with such protection, it would seem an excellent plan to re-model existing structures where practicable to provide this safeguard.

Questions

DR. MARTS: The safe places to be in case of air raids, speaking just of your personal safety, regardless of your responsibilities in any plant protective committee—the English tell us that the largest number of casualties were caused by those out in the streets; and the second largest casualties took place amongst those who were caught out in the street and tried to lie down behind some low cover; and the third largest number of casualties were those in their own homes; and the smallest number of casualties were those in the approved type Anderson bomb shelter, which we are not going to have in this country, at least for a year or two.

So if anyone asks you where to go in order to be safe, tell them to go nowhere, just stay home. Get away from a window and stay home.

Mayor LaGuardia has given some advice to the citizens of New York who may be in the skyscrapers. He has been advising them along the line of your own advice here in your paper, Professor Witmer; namely, that the lower floors of a modern steel construction skyscraper are probably about as safe a place as they can find. **I believe you said the five-hundred-pound bomb would go down perhaps ten floors?**

PROFESSOR WITMER: That's an estimate.

DR. MARTS: That seems to be Mayor LaGuardia's judgment, and his advice to the people of New York is to stay below the top ten floors of these modern skyscrapers of steel and stone construction. He is giving his people instructions, I understand, to lock the doors of the skyscrapers so people will not leave them in case of bombing, because his opinion is there will be far more danger if they dash out into the street, on account of the flying debris from the sides and roofs of these skyscrapers, than there would be if they stay right in the lower floors.

I didn't mean to say that much. I am here inviting questions from you. Have you any questions or comments to make?

Q. How effective is the sandbag placement idea?

PROFESSOR WITMER: I think I mentioned a thickness of 24 to 30 inches of sand or broken stone or earth would be effective in the exploding of a five-hundred-pound bomb at a distance of fifty feet. These figures are based, not upon calculated results, but upon experiments on the actual results in the City of London or other cities in England.

Q. Do they use that pretty extensively?

A. I think they do.

Q. What would be the approximate effective height of the horizontal force of a five-hundred-pound bomb? How high would you have to make a placement?

A. As I mentioned here, there are cases where the fragments have flown up as high as ten stories. Of course, how far they would go is hard to say, but I should say four or five stories would be as much as you might expect to be destroyed by it.

Q. What I had reference to was more in particular vital machinery in industry, that is, furnaces and things of that sort. **Could you have a low enough barricade to protect the vital parts of the furnace and still be able to work them?**

A. Of course, the protection of anything of that kind, I should say, would be from a bomb that exploded approximately at the ground level outside the building. If it came down through the roof and upper floors, I should say there is hardly any chance of stopping it; but if there is an explosion outside the building at a sufficient distance away, a protecting wall, either the building itself or one built inside the structure around the vital parts, might afford quite a good deal of assistance.

I would guess—I don't know, but I would guess—three or four stories would be ample to take care of it. The suggestion is made that the reinforcing of the wall be carried up at least three or four stories from the ground level.

Q. Is the use of a curtain or canvas over the windows at all effective in stopping flying glass?

A. Well, I should think it would have some effect. I don't know. My own personal guess is probably no better than yours. It wouldn't have much effect if it came at high speed. The flying glass might be stopped by it, but I don't think the fragments of a bomb would be interfered with.

Q. It is highly recommended by the British to paste canvas things of that kind on the inside of all windows and then reinforce that by chicken netting behind it to cover the entire areas of exposed glass, particularly in skylights.

A. Sounds very interesting. I should think it would have some effect.

Q. **How close does the bomb have to explode to the building to cause damage to it? In other words, I understand if it is fifty feet away it will still bang it up pretty well.**

A. The thicknesses of material that are given in this list that I quoted were based upon a five-hundred-pound bomb exploding at a distance of fifty feet, and those thicknesses were alleged to be a fair protection against the effect of that bomb. That is, steel plate an inch and a half thick; concrete or masonry walls from 12 to 15 inches thick, and broken stone or earth or sand from 24 to 36 inches; and I presume that answers the question as well as we can answer it.

I presume that is all based upon actual experience and studies, surveys that have been made of actual explosions. I don't think there is any way of doing it in a mathematical manner.

INDUSTRIAL FIRST AID

By DR. HUBLEY R. OWEN, City Director of Health and Chairman of the Council of Defense of Philadelphia

Of course, one of the first things that comes to our minds in so far as First Aid is concerned is the proper treatment of wounds, and you will hear various different accounts of how to treat wounds, especially with these different kinds of paints they put on them—mercurochrome, gentian violet, iodine, and so forth.

The modern treatment of wounds has progressed considerably in the last few years, and at the present time we are using chemotherapy. The favorite drug now used in practically everything is sulfanilimide. In practically all wounds now, not only wounds caused by operations, they are using sulfanilimide; and I don't think it is going to be very long before our whole conception of first aid treatment of wounds is going to be along the line of giving up all these different paints and using chemotherapy, sulfanilimide, or one of these similar drugs.

I have emphasized in lecturing to the police and firemen over a period of thirty odd years the great danger in using an antiseptic in wounds, because if you use any strong solution, and I include in that iodine, which personally I don't use, which is going to counteract the effect of germs in the wounds, it devitalizes tissue; and when you devitalize tissue, you weaken nature's resistance to germs.

That is the reason I am against all of these antiseptics. Of course, you can hold your hands up in holy horror and say, "Well, the universal teaching is to use iodine in wounds." The theory which is followed by a number of surgeons today is not to use any antiseptic in wounds except this new drug sulfanilimide.

If people will only come around as far as cleanliness is concerned, we will have less infection. What do you mean by cleanliness in treating a wound? We mean soap and sterile water.

Over at the Rockefeller Institute I had the pleasure of attending classes over there back in 1917. They taught that cleanliness is next to Godliness. They taught that the application of a neutral soap with a pledget of cotton and with sterile water to wash the area surrounding the wound, and if necessary the wound itself, then shaving the hairy parts around the wound, does more good than any antiseptic.

Of course, there are certain types of wounds which we are always fearful of in industry—badly lacerated and contused wounds, and the so-called punctured wounds, and certain wounds in which we fear the danger of contamination by tetanus bacilli—lockjaw—punctured wounds, especially wounds contaminated with street dirt, gunshot wounds, wounds received around stables, crush wounds where there is devitalization of tissue.

The last two cases which I had of tetanus occurred within a block of here. One of them was a man whose foot was run over and crushed. He developed lockjaw. The other was a little boy who had the end of one of his fingers caught in his bicycle chain and cogwheel.

As I go along, I will show you (by slides) some wounds which are apt to be contaminated by tetanus germs, gunshot wounds, wounds which we might ultimately have in this national emergency.

We evacuated twenty thousand cases in the Jefferson Unit in France, and we didn't have one case of tetanus. And those of you who were abroad know that the reason for that was that tetanus antitoxin was given practically in the trenches along with a preliminary dose of morphine.

The boy was tagged and sent back. The wound was dressed or the compound fracture was manipulated. During his convalescence, he received tetanus antitoxin again. And you were court-martialled, there was an investigation made of every case of lockjaw in the A. E. F. to see who was at fault. And if we had that here in civil practice in Philadelphia and other cities, it might be a good thing.

We lost eight cases of lockjaw here in Philadelphia in 1940, and six of those cases were preventable. Six of them were due to delayed treatment and failure to recognize the type of wound which usually is followed by tetanus.

So in your industrial plants, tetanus should be absolutely eliminated. And one thing that's going to be derived, I think, from all of our work with this Council of Defense, even long after the emergency, is the protection of your plants.

I hope by the time we get through with this, there will be organized first-aid teams in practically every industrial plant in this and other cities.

The treatment of wounds, the cessation or stoppage or checking of hemorrhage, the method of giving artificial respiration, the first-aid method of treating shock, the different diagnoses which are of paramount importance even in laymen's hands of heat exhaustion and heat stroke, and the application of splints, the Murray-Jones and Keller-Blake splints—if you carry that away with you, back to the industrial plant in your organized first-aid squads, that will be all that you will need in so far as first-aid is concerned.

When we discussed the question of the application of emergency fractures out in Chicago several years ago at the American College of Surgeons, Dr. Kellogg Speed told us all of an instance where a man suffered a compound fracture as a result of an automobile accident of both bones below the knee, and somebody was hailing a taxicab or automobile to put him in it, which, of course, would have done irreparable damage to the soft tissues. A Boy Scout in uniform said, "Let him lie."

> **The old adage which we are trying to preach throughout the nation is "splint them where they lie." That is, in all fractures wait until they get an ambulance where they have one of those types of splints, or a patrol wagon, and apply that splint before you move the person. You are going to lose fewer legs from infection.**

This Boy Scout would not let even a policeman move this man until the ambulance from one of the nearer hospitals came. They applied this Murray-Jones splint. But he stood his ground; he stood there until they applied the splint, and he was commended for it.

We are making preparations to have ample bed space, not only in our hospitals in the City of Philadelphia, but also in suburban areas. We are designing hospitals for the treatment of compound fractures as they are doing now outside London.

> **Tourniquets in the checking of hemorrhage. There are only two places in the body where a tourniquet should be used—one high up in the armpit, and the other, high in the thigh; and yet you see some teachers put a tourniquet around the forearm or down below the knee.**

A little knowledge is a dangerous thing; unless you know how to apply these tourniquets, you do more harm than good.

Of course, one of the most important phases of first-aid is rendering artificial respiration. Every man, woman, and child above fourteen years of age should learn how to give artificial respiration.

Why do I say fourteen? Because I have had thirty odd years' experience in the Boy Scouts, and every year I have gone up to their camp at Treasure Island for at least a day, and their first-aid work, their exhibitions for their merit badges, and so forth, are very admirable; and some of these Boy Scouts can give first-aid better than any classes that I know.

The old Silvester method of artificial respiration has been discarded. The Schafer prone method, of course, as you know, is the method now in vogue. **The Schafer method of artificial respiration should be the practice of all first-aid squads in each one of your plants.**

This comes down to the application of these splints which I mentioned. This slide was taken over at a meeting of the Hospital Center in New York. We had a fracture meeting up there one time. No nurse can graduate up there until she can apply this, which is a Murray-Jones splint, in four minutes, and also the one for the leg.

The great advantage of this "Splint them where they lie" is that you very often keep simple fractures at the outset from becoming compound fractures, and you save injury to the soft tissues, the muscles, the blood vessels, and the nerves.

Moreover, one of the great complications of fracture is naturally shortening. You can recall many people who have a leg that is from one to three inches short. You have to overcome the traction before the muscles set themselves in the spasm of the application.

> **Every industrial plant should have these two splints with a squad that knows how to put them on before they go to a hospital. In the same category, every industrial plant should have a first-aid squad that knows how to give artificial respiration.**

I have a short film I want to show you of methods of transportation of a back injury, which I think is so important.

I could mention to you dozens and dozens of back injuries that I have seen in the last thirty or thirty-five years which have been diagnosed as sprained backs, contusions of the backs, which were in actuality compressed fractures, and some of them were crushed fractures, causing constant backache, and ultimately in some cases weakness of the lower extremity on account of pressure on the spinal cord.

I remember two cases in the Women's College Hospital in the past few years. One woman had a fracture of both bones of one of her legs. We treated that, and it wasn't until she got up and around that she complained of backache. When we got her back to the x-ray department, we found she had an unrecognized fracture.

> **So in all these cases of back injury, especially when a person jackknives, falls in a bended position, and complains of back injury, they should be x-rayed for an unrecognized compressed fracture of the spine. As I say, some of them ultimately develop constant and perpetual backache.**

Now the method, of course, so often in vogue with any back injury is to pick them up promiscuously, sometimes by the arms and by the legs and sling them over on a stretcher any way at all; and every time you bend or jackknife that spine, you just aggravate an existing compressed fracture; and you may have a compressed fracture that becomes a crushed fracture.

It is imperative that all these back injuries be lifted properly. You can use a stretcher, or a straight board, or a shutter; face down, with the spine in an extended position. They don't allow any flexion of the spine at all so as to aggravate the condition.

I want to say if any of the plants wish any of these films, we have this film, and we have about four or five of the fractures of the extremities; we have artificial respiration, and a number of others. If any of you organize your first-aid teams and want to borrow them, we will be only too glad to lend them to you, of course gratis.

A patient having a broken neck must be handled very carefully. Any sudden motion of the neck may injure the spinal cord, resulting in total paralysis and instant death.

We have an accepted method of moving these patients, and many deaths have been averted by the proper handling of these fracture cases of the cervical vertebrae.

Extension of the neck must not be relaxed until the patient has been transported to the x-ray room of the hospital. The operator at the head of the patient holds his neck steady, while the whole body is being rotated so as not to have any rotation of that neck on the lower spine.

It's very easy with a fracture up to the first, second, or third vertebrae, by rough manipulation to cut the cord entirely. You may not have had a very severe injury to start with, but by rough manipulation you may cause a hemorrhage into the cord, cut the cord, resulting in permanent paralysis and ultimate death, because very few ever recover from a fracture of the neck; and when they do, life is hardly worth while.

QUESTIONS

Q. You were suggesting the use of sulfanilimide in wounds. Can a layman purchase that, or do you have to have a prescription?

A. That must be prescribed by a doctor. At the present time, I say, that's only coming in. It is in its incipiency. We have been using it over at the Philadelphia Hospital for some time for compound fractures; but I do think that before very long you'll be able to buy that as a dusting powder and use it for the first-aid treatment of wounds.

Q. Doctor, if a man has a broken back, would you give him artificial respiration?

A. The method of giving artificial respiration when a man has an injury to the back or to the chest is usually by what we call Laborde's method; and that is by false retraction on the tongue. Take a man who has an injury to his back, either a crush fracture or a compressed fracture; and he has, say, fallen under the walls of a fire, and at the same time he has been overcome by smoke. The thing to treat first, of course, is his asphyxia.

He is either in the first, second, or third stage of asphyxia. He isn't breathing, or he may be unconscious and still breathing. The thing to do for him first is to give artificial respiration. You will have to take care of the back injury afterwards, because if you don't take care, you are going to have a dead man with a fractured vertebrae. If you have a live man, you can treat his fractured vertebrae afterwards.

The question has often been asked me, "Suppose you had an injury in the chest, a fracture of the ribs? Suppose you had a woman who was seven months pregnant? You couldn't put her on her stomach and give her artificial respiration, because you'd have to be an obstetrician right there."

The way we do that is by Laborde's method. That is, we take the tongue and forcibly extract it from the mouth, and that gives you reflex action to cause a spasm of the diaphram. You let the tongue fall back, and count three just as you do—inhale or exhale—for artificial respiration.

Then you give the tongue another yank and cause them to gasp, so ultimately by this reflex action of the tongue—it doesn't hurt very much, especially when you're unconscious—you finally establish artificial respiration.

The only other way you can do it is in the hospital, and that is when you put an intratracheal tube right down the windpipe. Then you connect it with an apparatus outside. Then you are giving artificial respiration.

But, of course, treat your asphyxia first, because you are going to lose your patient if you don't resuscitate him from his asphyxiation.

INCENDIARY BOMBS

By MAJOR HAROLD R. BRAYTON, U. S. Army, Division of Chemical Warfare, Edgewood Arsenal, Md.

I'd like to disillusion you just a little bit as far as incendiaries are concerned. You may think that incendiaries are something brand new, but they're not. They have been going for thousands of years.

When man discovered that fire was a friend, he also discovered shortly afterward that it was an enemy and could be used as a weapon, and for that reason they have been using fire as a weapon.

But I will say this—that in modern times incendiaries have really come in to their own, due to the fact that **with the development of the airplane, it is possible to carry the incendiaries in large quantities**

and put them down where the want to. That is why we are particularly interested in the subject of incendiaries when we are considering Civilian Defense.

We know well enough that if an enemy is going to attack the Atlantic Seaboard here or anywhere in the State of Pennsylvania that first of all he's got to have a target. Now, we are not going to talk about it. Each of you men knows what your targets would be in your local communities, and for that reason, I'd suggest you start with that in mind.

> **What establishments or what organizations would be likely to be attacked by enemy planes dropping incendiaries? Second point: Your target must be within striking distance of the enemy who is going to make the attack.**

We all know that back in World War days, the striking distance of an incendiary, one of those phosphorus grenades, was about as far as a good baseball player could heave one. We know that a little bit later they developed rifle grenades which could fire phosphorus-loaded grenades a little bit further; and then we were able to put out phosphorus in the form of mortar shells or artillery shells; but at best it was a very poor expedient. But when the airplane came, then it was possible to reach almost any distance desired.

A point that we'd have to consider in figuring whether we are going to be attacked by incendiaries is that the target they are going to hit must be combustible. By combustible I mean that the ordinary incendiary which is dropped is not going to set fire to anything in the nature of concrete or steel. It's not going to do any damage out in the streets or on the lawns.

So figure in taking an inventory of your community whether you have a lot of flimsy roofs; whether you have combustible roofs; whether you have roofs which are weak enough so that a bomb, say, weighing about two pounds to four pounds, falling five thousand feet and hitting with a velocity of 350 to 700 feet per second, see whether or not that bomb is going to go through that roof and set a fire inside the building.

One of the most effective incendiaries which has been used is a plain metal. You've heard them speak of magnesium bombs. Here's a tube of the metal-bright, shiny metal; looks just about like aluminum or nickel or any other kind of metal.

Here it happens to be a tube of metallic magnesium, about 96 per cent magnesium; and, **as surprising as it may seem, that's the thing which has been doing about 90 per cent of all of the damage over in England.**

This happens to be a magnesium bomb which was dropped on the streets in London. The firing pin which was in the head of this bomb did penetrate the detonator, the primer cap—actually set off that cap.

Now I could touch a match to this shell of magnesium, and I could never get it started. I am just going to take a little piece of this, and if I have any luck, I can show you that it is a very simple matter to set fire to magnesium. (Demonstrates.) Notice that brilliant white light. If incendiaries are ever dropped, that's the thing we should watch for.

If you get one that burns with a brilliant white light like that, you can depend on it, that's magnesium. This powder we get and the smoke we get from a magnesium bomb is not going to do any damage. It's perfectly harmless.

As I say, we can't set fire to a tube of magnesium like that. We've got to have some sort of a firing mixture in there; and so, the Germans have made use of thermite as a core filling. Now the thermite as an incendiary is not a very good incendiary.

It has just one purpose in the filling of this bomb, and that is to reach a very high temperature, about 4,500 degrees Fahrenheit, to melt this case, this magnesium shell; and when this magnesium shell melts and runs out on the floor, it looks just about like quicksilver.

Then that magnesium begins to burn, and I think the latest figures which some of the laboratories are putting out on the burning temperature of magnesium are about 3,300 degrees Fahrenheit.

So the fourth point which I mention, the incendiary must be easily ignited, is taken care of in this particular 2.2 pound size bomb which the Germans are using. It is easily ignited by the thermite core which is in their. Don't think that we have to use a fuse to set this off. Don't think that we have to have some special igniting device other than just plain impact, forcing that pin up into the detonator and setting fire to your firing mixture in there, and that in turn setting off the whole thing.

All right. The next point is that your incendiary should burn with high enough intensity so that we can insure that the material will catch fire.

Now by high enough intensity, I mean something that's a little bit different than gasoline, or light oil, or something of that sort. It's possible for us to set fire to some gasoline. I have actually done it. We have fired some gasoline-filled bombs inside of a building to see what effect they'd have.

There was a terrific blast; all the sheetrock was blown off the walls of the building, and still that thirty pounds of gasoline in there just burned up without setting fire to the building. We didn't have to call in the fire department to put it out.

That's what I mean that we don't get the intensity of burning with some of those light incendiaries. Take white phosphorus as another example. That melts at 111 degrees and takes fire and burns at about 113 degrees; but still I could burn a piece of white phosphorus on this tabletop, maybe burn a five pound piece of it. There may be a little bit of charring of this wood, but there is not a high enough intensity of that burning to set fire to bulk material.

So we've got to have an incendiary which is capable of doing that, and this is one which does it—magnesium. That is why I am talking mostly about magnesium incendiaries.

The next point is your incendiary should burn for a long enough period of time that it can insure you get good burning. This particular bomb weighs 2.2 pounds; if on a steel plate, it will burn about twenty minutes. That's the actual burning time. If we have it on an ordinary wooden floor, it will burn all the way from twelve to fifteen minutes. That's assuming the wood is dry.

If we burn it on a wet surface where there is moisture, it is going to burn faster; and if we put a spray of water on that and make it burn still faster, it's possible to burn this thing out in about two minutes' time; but still at that, we've got a long burning incendiary which is capable of doing the work under pretty abnormal conditions.

Another point—the incendiary in order to be effective must be difficult to extinguish.

Now going down the line and considering some of our incendiaries which are commonly handled, take white phosphorus, for example. I have mentioned that. That's capable of giving a very painful burn. It puts out an awful lot of smoke, but it's one of the poorest incendiary materials that we have.

It's effective, of course, in dry grass, hay, fields, woods, and so forth; but other than that, it's a very poor incendiary. That material can be extinguished very readily by simply spraying it with water. We keep that white phosphorus under water to keep it from igniting spontaneously.

Take oil, for example. If we were to take an oil bomb which was about this size, and that thing should catch fire, counting the weight of the shell necessary to carry it, we'd only have roughly around a pint of oil or gasoline or material of that sort. Now, how much trouble would any of you have putting out a pint of oil?

If we take a heavy oil, we can expect that we are going to have to use larger quantities of it; and so if oil is used as an incendiary and the Germans are using some of it, you'll find they are going to use hundred pound bombs or up to two hundred fifty-pound bombs, holding maybe fourteen to sixteen gallons of oil. Now that oil is hard to ignite. They have had any number of duds.

But if we get a mixture which is approximately 80 per cent heavy oil, say about the quality of Diesel oil, and about 20 per cent of a light oil, it's capable of igniting without much difficulty; **but still and all, oil has only accounted for probably five or six per cent of the fires in Britain.**

Another point is the incendiary should be light enough so that the enemy can broadcast it in tremendous quantities. Take an oil bomb, two hundred fifty pounds, compared with one of these bombs, two pounds.

You can see the difference in the number that a plane is going to be able to carry; and one bomb hitting one target is only going to start one fire; but if at the same time you were capable of carrying, say, a thousand of these small two-pound bombs in a plane, just dump them loose, let them broadcast over an area of, say, about one hundred yards wide and one hundred yards long, you can see that you have a possibility of a large number of fires. So the lightness of the material is going to play a pretty important part.

> **Remember on these small bombs, the enemy does not aim these bombs. You might think that this metal tail on here is for the purpose of pointing this bomb at a target and letting it go; but that's not the case.**

They drop these, about thirty-six, in what they call a stick. These are placed in this box—if you can just assume we have four of these placed around here like this on a little metal base. There's a rod runs up through the center of this.

We put four of those bombs in this position. A piece of felt comes over that; then four more, another piece of felt, then four more. In other words, there are twelve of them on that one base; and then they put together about three of those sticks, **making a total of thirty-six bombs which are turned loose at one time;** and if a plane is travelling along, say, at about two hundred fifty miles per hour, and he's just kicking his foot and releasing those as he goes along, say, about one per second, you see there are going to be quite a few bombs turned loose. It's not going to take him long to get rid of those bombs.

As they fall, they are going to fall in all directions. This will have a tendency to guide the nose down, but they tell me the principle adavantage of this tail is not to guide the bomb, but to make a shrill, shrieking noise as these bombs fall through the air and just scare the folks to death down below. They think a high explosive is going to come down on them.

You have heard of those whistling shells. That's the purpose of that tail.

> **Just keep in mind that if you are ever attacked by incendiaries, you are going to be attacked by small incendiary bombs, large quantities of them, the purpose being to start a large number of fires.**

Now another fact, of course, is the incendiary must be cheap enough to enable the enemy to put out tremendously large quantities of them. I don't know how long Germany is going to continue using this particular type of bomb. Incidentally, the date on this bomb is significant—1936. They bought up a large amount of magnesium back there in '36 and '37. Whether there is enough of it to go on, I don't know.

When this firing pin on impact sets off this firing mixture and starts this to operating, it takes around fifty to sixty seconds for this core to burn out, to melt the shell—about fifty to sixty seconds.

So the old ruling used to be, never attack one of these bombs until about fifty to sixty seconds had elapsed.

But then the housewife could come up to the bomb with a shovel or even kick it out of place; if it hadn't gone too far, she'd grab hold of it and throw it out of the window. That was getting too easy for the housewife, so the Germans decided they'd make it a little bit more difficult. So down here near the other end, in about one out of every fifty, they put a little explosive charge.

That wasn't an explosive sufficient to wreck a building or do very serious damage, but it was enough so that when this core burned down to this end and set off that explosive, there were going to be pieces of burning metal; and perhaps this tail would fly and there were several people killed as a result of that explosion. The big purpose of that explosive in there was to scare the housewife so that she was going to watch herself.

So the rule they are now making is to wait about two minutes before you approach one of these. If it doesn't explode within two minutes' time, you know that there's not an explosive charge in there and the thing has melted.

Now as to the question of how to handle magnesium incendiary bombs. There is a lot of argument pro and con as to what the best method would be. We still contend that the best method of handling a magnesium incendiary bomb is the use of water, but water properly applied.

I'd like to have you all warn the housewives, and remember they're the ones who are going to fight these fires, never to run up to a fire with a dishpanful of water and just dump it on that burning bomb. If she does, that metal is going to scatter in all directions.

She is going to be badly burned and scatter the fire rather than control it; but by approaching that fire with any kind of portable extinguisher, or a garden hose, or one of these bathtub adapter hoses which are so commonly used, using a fine spray on that magnesium, you will keep the fire right in its place.

You will wet down the wooden surface and material under the bomb, and you will prevent the spread of fire.

The British are using what we call stirrup pumps, and they are very effective pumps—just an ordinary metal bucket, and they have a little barrel pump, and they stick that barrel down in the bucket; they have a little pedal over here that they put one foot on. They have thirty feet of hose on there with a little slide at the end of the hose. That little slide tip on the end of the hose has two sizes of opening. One is a small one, and one is a large one.

When the housewife turns it this way, the large opening is exposed, and she gets a jet or solid stream of water; but when she presses it the other way, she gets a spray.

And the rule is, put the jet of water on a fire; the spray of water on the bomb. Get the connection of those two.

In other words, if that magnesium has spattered, and if there is any moisture around, it's going to spatter—suppose it has set fire to some curtains in the neighborhood—put the jet of water on the curtains. Never let your fire get out of control; and then as soon as that fire is knocked down, put the spray on the bomb itself.

Now the question as to substitutes for stirrup pumps. I don't think it's necessary for us as a country to swing into the development of one particular type of pump, because fire departments and industrial establishments have other types of extinguishers which have been in use for a good many years.

I know a good many of you have used these plain old-fashioned pump cans. The can may be about this big around and probably a couple of feet tall; it holds five gallons of water, with a pump in there. All that's necessary in that particular type of pump can is to put your finger over the tip of the nozzle and spray the water; or if you want to, you can get those little slide nozzles that fit in the end there and apply those.

It's a little bit better if we use about twenty to thirty feet of hose on the end of that thing, because then we have only one man exposed to the bomb. It's, of course, going to require two or three people to operate the pump under those conditions, but sometimes it's a little bit better.

The man at the end of the nozzle can fire around the corner and put out his fire; and one man operating at the pump, and a third man carrying the water and dumping it into the bucket.

> **Incidentally, it takes about six and a half gallons of water to put out one of these bombs. I say "put out," I mean burn it out. We don't put them out. You can't put them out with water.**

Now suppose in place of water that we were to try some of our other types of extinguishers. We might just mention two or three types commonly used. Your soda and acid extinguisher is essentially nothing but a water extinguisher. We have the acid and the soda in there to generate pressure to drive the two and a half gallons of water out of the extinguisher.

That is going to give you a pretty solid jet of water, and in case you are going to use that type of extinguisher, you are going to have to handle it some way so you will get a spray rather than a solid jet, because you don't want to throw the burning magnesium all over the place.

I will just leave it up to you whether you can put your finger over the end of that tip and feather it down to a spray, or whether you will get further distance and get it to spray on the bomb.

Another type of extinguisher is your foam type. Some people are quite favorable to foam, and, of course, **foam is the best extinguisher we have for our oil fires; but if we apply foam to a magnesium fire, we do not put it out any more than we do with water.** We do get it down a little bit, but we put a coating over there, a covering over there, and that liquid seeps down under the bomb.

If you don't have other types available, just go ahead and use your foam and cover it up, but remember it is still burning underneath. You can't put it out. You will have a regular volcano there —a little jet of fire shooting out through that big pile of foam.

Carbon dioxide extinguishers—your dry ice or snow type of extinguishers. Even though you get a tremendously low temperature there, it is not sufficient to overcome that 3,300 degrees burning temperature of this. I have covered one of these bombs with six inches of solid carbon dioxide snow, and she burns merrily underneath.

> **We can go down the line and mention a number of other types of extinguishers, but none of them of the liquid-type extinguishers are capable of putting out the fire. They may control it some, but they will not put it out.**

Well now, what about our solid or powder extinguishers? If you were to use bicarbonate of soda, ordinary soda, which is the ingredient in a large number of our dry powders, you will find that when you pile soda on top of one of these bombs, it burns brighter than ever. It's not going to put it out.

If you apply sand over the bomb, let's remember that you have piled the material over the bomb, but the sand has not cut off all of the oxygen. Sand is porous. The oxygen is still in there, and your molten magnesium is going to continue to burn, and probably within three or four minutes that molten magnesium is going right on down through the floor and set fire to something down below.

One thing I would suggest by all means in using any kind of dry-powder extinguisher, sand or anything else, have a long-handled shovel with a square nose; get under that pile of sand and magnesium just as rapidly as you can with that shovel, scoop it up, and then either transfer it over to a bucket in which you have about four inches of sand and carry it out of the building, or if you don't have a bucket handy, transfer it to another pile of sand alongside the bomb, so that it will not burn through.

According to our tests, we find if we have two inches of sand surface, that bomb can burn harmlessly on the two inches of sand and will not set a fire below the two inches of sand.

But don't misunderstand me. If one of these bombs is hurtling down through the air at three hundred feet per second, and it comes through your attic roof and hits your attic floor, and you have two inches of sand over that floor, **remember the impact is going to kick that sand away, and the chances are you are going to have a fire there.** So there should be some means of protection.

One method which we are trying out and which has proved very effective down at the Arsenal just as a demonstration is we have put our two inches of sand on the attic floor; put paper underneath to keep it from sifting down through the floor to the room below; then just take some ordinary wire netting—we use quarter-inch mesh wire netting—spread it across six inches above the sand; and we feel that as that bomb comes down and comes through the roof, of course the roof is taking up a large amount of its velocity, and when it hits that wire netting, it is going to give, and it will continue to burn on the surface of that wire netting, and the two inches of sand will protect down below.

In putting any solid material in an attic space, you want to remember you have to take into consideration the added weight that you are putting up there.

So that was just a little idea—instead of using six to eight inches of sand, which must be used to prevent against the impact of the bomb, we use only two inches of sand and the wire netting above to take up the slack. That's just one of the methods that we were trying out.

Now other dry-powder extinguishers. You have heard them mention talc. If talc is available it does a very good job. Powdered asbestos has been tried, and it all depends on the amount of moisture which we have in the asbestos.

Asbestos is a mineral which has water in its chemical makeup, and we have found that the ordinary asbestos powder, when we put it on one of these burning bombs, just spatters twelve to fifteen feet in all directions. It takes the moisture out of the asbestos mineral and throws it in all directions; so even though asbestos is a fire-resistant material, it would surprise you what it will do.

We have tried dry Portland cement, and we did not have any successful results with that.

There is a commercial powder which we have tried out, this Pyrene G, a powder put out by the Dow Chemical Company and the Pyrene Company that for industrial plants does a very good job of extinguishment. That is largely graphite with a little bit of pitch in it, and it will actually coat the bomb.

We have also tried just ordinary coal tar pitch, and we have tried some petroleum pitch, and we find if we get that on properly we do get a very good coating over this bomb; and we have succeeded in putting several of them out. But I wouldn't recommend that the housewife carry a lot of material like that up in her attic; and it's got to be properly applied.

So let's say water properly applied is the best method of controlling or handling magnesium incendiaries; and secondly, some material which is handy and available, like sand or dry earth or something of that sort; but, of course, that's going to mean that the equipment must be at hand and ready to use. We've got to have it there ready to use.

I don't know whether it would be worthwhile going into a discussion of any other points in connection with incendiaries. I have mentioned the fact that oil bombs, if used, are going to be in large-size bombs, probably one hundred to two hundred fifty pounds. In case of a large bomb, that bomb is not going to lodge in the attic.

It's going on through and come down to one of the lower floors, and it will probably have a bursting charge in there different from this bomb, have a bursting charge which will throw it all over the room; and you'll have a bad fire on your hands.

Our phosphorus is probably not going to be used except against special targets, and so far I don't think any of it has been used. Thermite as an incendiary you might think of as doing a splendid job; it gets a temperature of around 4,500 degrees, but thermite is about four and a half times heavier than magnesium, and even though it does give that high intensity of burning, greater than magnesium, still it burns out in just about fifty to sixty seconds' time, so it's a short burning incendiary. You have to hit your target and get it on there in order to do the work.

I'd like to leave this one other thought with you. Assume a plane drops a thousand to fifteen hundred bombs. All of those are not going through the roofs and set fire. If you were to look down at a city, say, like Philadelphia here from a plane, you'd find that only about one-fifth of what you see down below is roof surface.

The rest of it is streets, and lawns, and open lots, and so forth; so that you are only going to have about one-fifth of the bombs likely to hit buildings.

> **Well, by the time you figure that they hit sharp roofs and glance off, or we have duds in our bombs, you are going to find that only about one out of every twelve bombs is going to penetrate and start a fire.**

So it looks as though we don't have such a job, but then on the other hand, figure that you have seventy to eighty fires started in a three-mile strip of country, what fire department is going to be able to handle that sort of situation?

That's your problem. It's not the fact that they're serious, I mean dangerous to handle; it's not the fact that the fire department can't handle the situation. They can put out any one of them without any trouble.

But it's just the fact that we are going to have so many of them at the same time that it can assume conflagration proportions unless your public is trained.

> **Remember the two important things—education and training. And that's the job, as I see it, that you men have ahead of you in your plant organizations.**

I don't anticipate in your plants, which are steel and concrete, that you are going to have to worry about these small incendiary bombs. You may have some larger oil bombs, but I don't anticipate the magnesium bomb is going to be used effectively against heavy construction.

Q. If that little two-pound bomb is allowed to burn on steel, over what area would it spread before it would burn out?

A. We find if we have a plate about two feet square, it remains on the plate. It will melt and run out probably about eighteen inches to two feet on a piece of steel, no farther. That is, of course, if it is flat. If is is tilted, it may run just like a liquid.

Q. I'd like to ask whatever happened to these pieces of paper the British Air Force used, impregnated with phosphorus, which were dropped about a year ago.

A. I think the British weren't very well satisfied with the results they got from those. They were little squares of celluloid about two inches to three inches square, with a little hole in the center and a little piece of muslin fastened over that. When they tried out the phosphorus, it took fire and burned, but I think they were a little bit disappointed in the results obtained. We haven't heard much more of them.

Q. What effect would carbon tetrachloride have on magnesium?

A. I'd say this—carbon tetrachloride, of course, is going to vaporize whenever it comes in contact with anything hot; and carbon tetrachloride is going to have an anesthetic action similar to chloroform. I would say never use carbon tetrachloride in a tightly closed room without plenty of ventilation.

As far as putting the fire out, it does not put it out. It does not have a cooling effect, and it does not have a smothering effect.

Q. What size fire would you have at the end of two minutes from one of these bombs? You advocated waiting for a period of two minutes. Wouldn't it spread if it landed on inflammable material? At the end of that time, wouldn't you have a considerable fire before you could do anything about it?

A. I should have brought out that point a little better. I am glad you brought it up. In order to save time, we recommend, and some of you question, as to why we get down on the floor and crawl up on the bomb with one of these stirrup pumps or one of these extension pump cans.

The reason for that is if we have an explosive in the tail of this bomb, and we are down on the floor, crawling up on it, and we start within about eight feet of the bomb, that's about a safe distance to start operation, if we will take a chair or kitchen table or just a raincoat, an overcoat, or something like that, and hold it up over one arm, and then direct the spray with the nozzle, we have protection for our face.

Therefore, it would be possible to attack that bomb just as quickly as you can get at it, if you have that preparation ready. That's the thing you should watch.

Q. Is there an oxidizing agent with the magnesium?

A. The oxidizing agent which is in the core of this bomb is your thermite, and your thermite melts your magnesium, and then we depend on the oxygen in the air tó furnish the oxygen to burn it up. Incidentally, when water hits that, the magnesium removes oxygen from the fine spray and combines with it and liberates hydrogen gas, which is combustible, of course.

The reason we recommend not using a solid stream of water is that that solid stream of water will penetrate down into the bulk of the metal. Say you have magnesium shavings. It will form steam down in there which is liable to blow the thing up, and at the same time hydrogen will be formed down there, so you've got two explosive gases there which are liable to blow that pile of shavings in all directions.

In plant operation where you have any collection of magnesium shavings, never allow them to collect around your machinery. When you get five or ten pounds of magnesium shavings, get them out of there, have them in a safe container, and do not allow them to get moisture on them, because the least little bit of fire may start that magnesium burning, just as we did with this piece of ribbon, and when it once gets started with moisture present, you really have a job. You can't do anything with it.

Q. What happens when a magnesium bomb which is not explosive is immersed in water?

A. If it were dropped in a bucket of water while the thermite core was burning, the thermite would continue to burn; but as soon as your thermite is burned out, your magnesium fire would probably go out. Now if you had that in the form of hot melted magnesium, and you dumped the hot melted magnesium into a bucket of water, you are going to have an explosion, the same sort of explosion you'd get with any hot metal.

Q. If you flooded the roofs of the plants to a depth of say two or three feet, then that would be a protection against those.

A. I am not so strong for that, to tell you the truth.

Q. They tell me they used to cover the old plant up here in Philadelphia to a depth of six or eight inches during the Fourth of July celebrations.

A. There would be no fire started, that's the truth. I am thinking of that extra weight. That's all I can say about that.

Q. What type of roof is most resistant to those bombs and which is the least?

A. Well, according to the figures, I think it takes roughly close to a quarter of an inch of mild steel to resist the impact of one of these, falling from five thousand feet; it takes about four inches of concrete; and it takes about six to eight inches of sand or dirt to resist that impact.

Q. What effect would a steam hose have if played upon a magnesium bomb?

A. We found as a result of experience that if we use a real fine fog stream of water on one of these bombs, it will control it all right; but it is very, very slow in burning out. In other words, we can't burn the thing out in two or three minutes' time. It takes longer.

If we were to apply steam, which is already water in its vapor form, it would be still slower, but your bomb would not gain any headway, and the chances are your steam would get down under the surface and protect it; so I'd say steam would be all right. It could not cause an explosion there.

Q. What effect would dry soapstone have on that bomb when it was burning?

A. Dry soapstone is similar to your talc that we mentioned, and it will do a very good job. The only reason we are not talking about some of these special dry powders is the fact that in different parts of the country they may not be available; but if you have plenty of soapstone or talc, it is perfectly all right to do a good job.

PLANS OF THE O. C. D. ON PLANT PROTECTION

By LIEUT. COMMANDER S. J. SINGER, U. S. N. Reserve, Attached to the Office of Civilian Defense

As you know, the Office of Civilian Defense was established by the President of the United States by executive order last May. He appointed Mayor LaGuardia of New York as Director of Civilian Defense, and assigned three specific duties to that office.

The first was to make plans for the protection of the civilians throughout the country; second, to coordinate the plans of the states, cities, and other municipalities; and third, to permit the volunteers to participate in the Civilian Protection Program and to sustain the morale of the country.

It's a big job, and the office has very little power, almost none. All they can do is advise, coordinate, and cooperate, and depend upon the voluntary participation of everyone in their efforts.

The Office roughly divides itself into two parts—the Civilian Protection half, which is designed to care for the lives and property of the civilian population in the event of enemy action whether by bombs or sabotage, whether by open enemy action, such as air attacks, or by the work of Fifth Columnists. That's Civilian Protection.

The other half of the Office, which is headed by America's number one volunteer, Mrs. Roosevelt, works out the plans for getting the ordinary civilian interested in the Civilian Protection half of the Office; and also they have a long-range program which provides for health, welfare, nutrition, and recreation. **The Civilian Protection half of the Office is the one we are interested in.**

We are all here as representatives of industrial organizations or municipalities, and the Civilian Protection half is a quasi-military job which must be done by people who are not used to discipline, by people who must be enrolled, trained, taught discipline and taught to keep cool under all circumstances.

More and more the Government is finding out that not everything can be controlled from Washington; so they divided the country into nine Civilian Defense areas co-terminus with the Army Corps areas, and appointed an outstanding man in each area as Regional Director.

The Regional Director has a setup almost exactly the same as the national office. They have Army representatives, Navy representatives and representatives of the Red Cross and other national and state activities.

As I said, the national office has virtually no authority, and, therefore, the Regional Director must work in close harmony with the State Defense Council and the Local Defense Council.

Now that's the setup, and that's how they are organized, and any time you want any information, you can get it by going to the Philadelphia Defense Council, to the State Defense Council, or any other local organization.

Defense has been divided into three elements, (1) Internal Security (2) Passive Defense and (3) Active Defense.

"Internal Security" embraces the safeguarding of a plant from sabotage, espionage, fire, robbery, and involves plant protection, traffic control, care and selection of employees, alarm systems, and security of the essential utility services. **In brief, "Internal Security" is the safeguarding of a plant from any act, except open attack, which might disrupt its normal efficacy.**

"Passive Defense" embraces all of the measures necessary to minimize the effect of damage resulting from enemy action. It includes the precautions to be taken prior to actual attack to minimize and restrict the damage, and in some instances comes into active operation upon the commencement of an attack.

"Air Raid Precautions," which is one phase of "Passive Defense," includes such things as air raid warning alarms and systems, fire prevention, incendiary bomb control, illumination control, camouflage, chemical warfare, first aid measures, handling unexploded missiles, rescuing shoring parties, damage surveys, clearance of debris, wrecking provisions, repair provisions, bomb proof air raid shelters, evacuation, police protection, supplies, feeding, housing, etc.

"Active Defense" of course embraces the operational elements of the Army and Navy, designed to prevent the enemy attack from reaching its objectives.

> **All of these overlap, mutually support and augment each other. At no place is there a clear line of demarcation between them. We must be strong in all three if we are to be prepared for whatever may come.**

Of course, the plants do not participate in the active defense, and thus Internal Security and Passive Defense are what they must prepare for. What we are after is the safeguarding of the plant plus the minimizing restricting and controlling of the effect of damage resulting from enemy action or other emergency.

To do this, it is the aim of the Office of Civilian Defense to have each industrial organization—self-sufficient—to prepare for internal security and for passive defense **so that it might, as far as is humanly possible, be able to stand by itself—independent of the surrounding municipalities.**

We realize that there must be the closest of cooperation between the city and the industrial organization and between the various industrial organizations. For example, there is no good in a plant having a blackout if the homes surrounding it are not also blacked out, and we therefore recommend that the person in charge of the plant protection scheme of any organization work in close unison with the local authorities and local defense councils.

Another good reason for this necessity is the fact that either the municipality or the defense council will be the first to receive the word of any possible air attack and if this word is to reach the industrial organization, there must be communication and close contact with the local authorities.

The city will have enough to do in looking after the ordinary citizen either at his home or in the store—will have enough to do in caring for the women and children and in the problem of keeping them cool, quiet, fed and housed—without also having the burden of looking after an industrial plant which has men of proven ability who should be able to do it for themselves.

> **Therefore I repeat, it is the desire of the Office of Civilian Defense to have each industrial organization so prepared that in the event of an attack it is able to stand by itself without asking for assistance from the surrounding municipalities, unless that assistance is absolutely necessary.**

In cases of which I have read, the organizations of the industrial plants in Great Britain have been so good that in numerous cases they have been able to give aid to the surrounding municipalities rather than asking for aid and have helped each other when one was the recipient of a number of bombs while the other was not.

The Office of Civilian Defense has caused to be prepared and distributed a pamphlet known as "Protection of Industrial Plants and Public Buildings." This pamphlet is the studied opinion of experts, based upon experience in Europe, of a general over-all organization which would be prepared and ready for any eventuality. It is a guide which may be adapted to any organization—it is not mandatory, it is only something which we offer for the general over-all picture of precaution. The plan is simple, plain, understandable and workable, and if followed wilil give a squad of men for every possible casualty.

Small organizations may adapt this plan by assigning more than one duty to a squad.

When bombs drop, there is no means of telling what will happen and this plan covers every possible happening. The plan was written very generally because we knew that you gentlemen knew your plants, knew of what might happen, and could get into the details much better than anyone sitting on the sidelines.

However, we do know that you would like to have some pamphlets which tell you of some specific things to do—therefore there are now being prepared various technical pamphlets which will attempt to give you specific details—but no two organizations in the Country are alike—no two organizations have the same setup—and it is strongly recommended that you prepare your own technical details and your own check-off lists.

The check-off lists are important—in times of stress, no one can think too clearly and any written aid is valuable.

Rear Admiral C. H. Woodward of the U. S. N. is the Navy Department Member of the O. C. D. Board for Civilian Protection and is in charge of "Plant Protection." Admiral Woodward's last call of duty was as Commandant of the Third Naval District and Commandant of the Navy Yard at Brooklyn, New York,—which is one of the largest industrial organizations in the Country. Therefore, in addition to his Navy experience, he has that industrial experience which is so necessary for the job.

To bring to the attention of the industrial people a general picture of what is necessary, Admiral Woodward is encouraging the establishment of schools such as this one. In nearly every state along the Atlantic seaboard, from Maine to Virginia, schools have either been conducted or plans for their early establishment are underway. It is hoped within the very near future to commence the establishment of schools along the Southern half of our Atlantic coast and along the Western coast.

We recommend that industrial organizations send a qualified senior executive to these schools or to Edgewood Arsenal and if this is not possible, that they take advantage of the various warden schools and lectures given by the various local defense councils and such other schools as are available.

Some of the industrial magazines of this Country are now engaged in working up material for their magazines on our phase of the work. These articles as a general rule will be specific and will tell specific industries of specific things to be done.

The various regional offices of the Office of Civilian Defense and the State and Local Defense Offices are always more than willing to cooperate. As far as possible, they will attempt to answer specific questions and if they are not able to do this, they will secure the necessary information for you. It is strongly urged that you maintain contacts with those offices so that you may know of the latest developments in the precaution field.

If you have a defense contract, the F. B. I. will look over your plant and advise you what additional precautions, in their opinion, should be taken by you to properly safeguard your plant. In addition, the F. B. I. has issued a splendid pamphlet entitled "Suggestions for Protection of Industrial Facilities."

This pamphlet up to now has covered plant protection in the sense as used by them, but the new printing will include a chapter based upon our pamphlet "Protection of Industrial Plants and Public Buildings," and will cover precautions for air raids and other emergencies in addition.

It is a secret pamphlet but is available to industrial organizations, and I recommend that you request a copy from the F. B. I. Copies will be given to you upon your request if you are in a defense project.

> **The F. B. I. is charged with the prevention of sabotage and espionage and has the sole responsibility therefor. It is a detective job which they can well do—so don't try to do it yourself.**

If you have a contract with the Army or the Navy, the M. I. D. (Military Intelligence Division) or O. N. I. (Office of Naval Intelligence) will also be willing to give you this same service. Another means of securing this is by request to your insurance companies. We do not recomemnd that additional surveys be conducted. We know that you have too many surveys and what we are after now is to avoid a duplication of that.

I was told recently of one plant which had had 14 surveys by various Federal, State, City and Insurance organizations. Unfortunately there is not much that can be done about it, but we are working on this problem and hope to avoid any similar incidents and certainly shall not conduct any surveys ourselves.

We are not asking any industrial organization to spend money. The important thing at the present time is production, but at the same time we know that the necessary plans for the protection of your plant can be developed now. There is no need of building large bomb-proof shelters for the employees. There is no need of duplicating your entire plant.

> **We have enunciated the principle that decentralization, dispersion and duplication are sound. However, we do not expect that this will cause any plant to immediately try to duplicate its plant. However, we do believe that if there is one place in your plant where, if damage occurred, it would seri-**

ously affect production that, other things being equal, this plant should be given every possible protection and if possible duplicated or replacements made ready.

One of the things we want is for each organization to have its plans—ready to put them into effect, and to have trained squads ready to do a job. **This requires study, thought and preparation on the part of the management and preparation and training on the part of the employees**—who will gladly cooperate when shown that it is a cooperative affair—for their own safety as well as for the safety of the plant—and it is in defense of our Country.

You must have a general cooperation—because there is no difference in the responsibility of management and the ordinary householder or worker on matters of defense except that of scope and degree. Failure on the part of any one management, employee, or citizen, might result in nullifying any effort of the other, no matter how thorough the preparations had been.

In the selection of key men, temperament, natural leadership, coolness and ability to act under stress are important features to watch. Have your key men know their job and have them train their own squads so that they may know what is expected of them.

Each "work shift" should be completely organized. There is no knowing whether a raid will occur at day or night or how soon, so be prepared.

Have drills and inspections. Fires spread rapidly on debris, so inspect and keep things clean and spaces clear.

Remember always that it is a voluntary organization motivated by a desire to live, a spirit of cooperation, and patriotism.

Imagine every possible casualty and prepare for it. Let's look at some—Lights out—power off—elevator fails—telephones out—water mains broken—fire at several places—a motor runs away—people are hurt—a wall collapses—

Imagine several of these occurring at the same time—because if bombs drop that will happen. Are your men ready to do something about it or will they mill around and look at each other? Will the casualty be handled quickly and efficiently or will there be a lot of noise and confusion and no results? Will your motors be shut down before the man gets to safety or will he run away without thinking about his machine?

Children in schools have fire drills, and the teachers and janitors have specific duties. That is what we want of industry. The fire departments are maintained not so much to prevent fires as to prevent the spread of them. A bomber will get through and we want to prevent the fear, chaos and destruction, and we must maintain our industrial plants and our people.

It is a matter of fundamentals which must be brought to your attention and to the attention of your organization and it is the fundamentals, which in any emergency, must not be overlooked when time is essential.

I am of the opinion, after a thorough study of the situation, that plants are paying a lot of attention to guards and fire. **However, very little attention is paid to communications or to actual drills.** What will you do if your telephone goes out?—and they do go out of service very quickly. Have drills—slow at first with few men participating, but gradually getting bigger and faster. It will pay dividends when and if the bombing starts.

Study your plant, make plans for its protection, select your key men and train them—slowly but letting them know why and how—supply them with necessary equipment and—then train the individual squads and the entire organization.

Do not attempt to make it a hard problem. Handle it basically and keep it simple and you will get results.

We have had under discussion with the Wage and Hour Division of the Department of Labor the matter of training of employees and I shall read to you part of a letter which has recently been received from that Division:

> "The Division has been asked to rule on air raid precaution training programs conducted by an employer for his employees. Inasmuch as the problem may become national and Civilian Defense is under your guidance, I am advising you certain principles within which time spent in such training by employees need not be considered working time, and, therefore, they need not during such time be compensated by their employers.
>
> **"If an air raid precaution program is not limited entirely to the protection of the property of the employer and after regular working hours employees voluntarily engage in such a training program, the time so spent will not be considered hours worked.**
>
> "Individual inquiries to the Division concerning time spent in air raid precaution training will be answered by the Division according to the principles set forth in the preceding paragraph."

Thus you can see that it is the policy of the Government to encourage the training of these men. It is my opinion that any plan which provides for the safety of the man—as well as the plant—complies with this ruling.

QUESTIONS

Q. I'd like to ask Commander Singer to explain a little further about what he mentioned about the plants and institutions not spending any money. Because some of the elemental precautions that they will have to take, more specially in the matter of protecting the windows, are going to cost them something, and the windows are certainly one of the things that have to be looked out for particularly. There are also air raid shelters on the grounds, and things of that sort. I'd like to have him say what he thinks about the window question.

A. We do not think there will be any sustained bombing attacks. However, we do think there will be sporadic raids, and the expense of building large bomb-proof shelters will not be warranted if you are only going to have sporadic raids.

However, the gentleman did mention glass, and this afternoon you will hear a lot, I think, about glass. Glass is one of the things that when it is free and flying around does a lot of damage. To a great extent, they have either covered up the glass with canvas or tape, put chicken wire on the inside of it to prevent its flying.

A lot of places have removed glass entirely. Bear this in mind—this is my personal opinion—I think you should give consideration to it—what you will do and how you will do it—but I don't think you should go to the extent of replacing glass at this time.

Q. How about reinforcing it?

A. I don't think that I would reinforce it at this time, sir. If it got a little bit more serious, I might. That's my personal opinion.

FIRE FIGHTING METHODS

By PERCY BUGBEE, General Manager, National Fire Protection Association

It's an ill wind that blows no good, and this ill wind that we're subject to at the present time has blown this amount of good at least—that particularly along both of our seacoasts the public, the general public, has for the first time perhaps in our experience become somewhat fire-conscious and somewhat impressed with the need of taking at least the elementary steps to protect themselves against fire.

Other speakers in your series of talks have dealt upon the fact that the present time of warfare is very largely a fire war, that the incendiary bomb is perhaps the principal weapon used by the Germans in their attacks over England.

That is only one phase of the fire-protection problem that we have to consider, that threat of possible incendiary attack.

Another one, and perhaps even more important because it seems to me even more likely to happen, is the possibility of sabotage.

We have had little or no severe sabotage in this present emergency as far as the authorities and F. B. I. have been able to sense; and by that I mean little or no fire sabotage. Fire is the easiest weapon of the foreign agent that is bent on destruction. Fire was the principal sabotage method used prior to and during our experience in the last great war.

I think it is reasonable to assume—I know that the F. B. I. people think it's reasonable—that it is very probable if we are subjected to attack by a foreign enemy, it will take the form of widespread sabotage rather than incendiary attack, and that we might expect a blitzkreig type of attack all at once, all over the country, directed at key industries and key utilities, in an attempt to not only slow up the production program, but to very seriously damage the morale of the country.

And finally and perhaps equally impressive and important with these other two possibilities of fire is the pressing necessity that we have in this country today to keep the wheels of industry turning, and **we simply cannot afford fire destruction of essential commodities and fire destruction of plants that are turning out those commodities.**

The problem of essential fire-fighting methods, which I am dealing with this morning, the problem of fire protection of industries and of plants of all kinds, is not essentially a different problem in emergency times than it is in peace times. A fire is a fire and must be handled more or less the same, whether the fire is started by a foreign agent, by a bomb, or by an act of carelessness.

In general, it is safe to say that a plant that is properly protected, properly cared for in normal times, where the management has taken the proper steps to protect the plant against fire destruction, will be fairly well equipped to meet any emergency situation that may arise.

The chances of fire may be greater, that is true, because of the possibility of incendiary bombs, because of the possibility of sabotage, because of the induction into many plants of untrained workers, new men who haven't had the safety principles inculcated into them that the older, experienced men have had, because of the step-up of production by three shifts, where perhaps only one or two existed previously.

You have, therefore, increased possibility of fires, due to normal industrial processes taking place.

We do have this other difference in emergency situations, that we can perhaps no longer depend upon others, as was so clearly brought out by the previous speaker.

Now, as I see it, there can be stated five principles of fire-fighting methods quite simply, and those five are rather all-embracing. The first one of those is almost too elementary and too simple to bring to your attention.

It can be perhaps most simply stated by the old proverb, "Don't put too many eggs in one basket." Don't have too much valuable material, too many valuable machines or other processes subject to one destruction, to one fire.

If you need examples of what I mean, perhaps the one that will come most readily to anybody's mind is the recent fire that occurred last month in Fall River when we burned up 15,650 tons of Government reserve rubber in one loss, the largest single industrial plant loss we have ever suffered in the United States; so far as we can determine a loss of over $15,000,000.

That rubber was stored in an ancient building that was originally erected some seventy odd years before for a textile plant. The floors had been partly removed and the fire doors had been taken out so that the material to be stored in this building could be piled higher. It's true there was an old sprinkler system in part of the property, but totally inadequate to meet this particular hazard with which it was confronted.

And in addition to that, the watchman at the property during the early stages of the fire shut off the sprinkler system, and then it was reopened too late to be of any particular value.

I could cite many others, but those three cases do point this first of the five principles, it seems to me, of concentration of too much valuable material subject to one loss.

> **It is relatively easy to subdivide valuables with fire walls, with fire doors. In many cases if a little study is given to the situation, the efficiency of the operation is not reduced; it may even be increased, if you are operating a number of smaller units as against the one big unit.**

If there are occasions, and there may well be, when you have to have an undue concentration of valuables because of some situation, then most certainly very special methods of fire protection should be set up to take care of that hazard.

The second principle, and here again I am dealing with elementary things, is to **eliminate in any industrial property or other property the obvious things that might cause a fire.**

Last year we had roughly 35,000 fires in industrial plants in the United States.

An analysis of those fires demonstrates very clearly that the vast majority of them are due to things that any one of you would recognize as elementary causes of fire—things such as poor housekeeping which permitted accumulations of rubbish of one sort or another which any stray spark from a grinding wheel or a cigarette or anything else sets off and causes fires; the careless smoker, the poor maintenance of electrical and of heating equipment in plants, the careless handling of flamboyant liquids, the failure to protect adequately welding and other operations, using machines which cause sparks or open flames or fires.

Those are the things that cause the vast majority of industrial plant fires. Those are the things that can be readily taken care of by intensive inspection, by a recognition by the management and by the responsible employees of any plant that the simple precautions to prevent fires must be maintained.

Now third, it seems to me, is a recognition of the fact that in most areas any property is reasonably accessible to some sort of municipal fire service, and by that I mean that **many of these very disastrous fires that we have had have gotten away and become big fires because of the failure of people at the property to call the municipal fire-fighting forces to come and put out the fire.**

We had a very disastrous fire in Boston quite recently which destroyed over a million dollars' worth of food materials, because of the failure of the employees at the plant to call the Boston Fire Department early in the stages of the fire.

The disastrous Jersey City water front fire which caused thirty-four deaths and a property loss of over $5,000,000 was primarily due to the failure of the employees at that plant to call the fire department forces into action.

Now fourth is **the installation of adequate and proper private fire protection into the plant.** I think any industrial manager will recognize the fact that there are certain private fire protection appliances available that have had a very satisfactory and widespread recognition.

The automatic sprinkler system is perhaps the best known and the most effective of any system yet devised to take care of industrial fires. Our association has a record of over 50,000 fires that have occurred in buildings equipped with automatic sprinklers, and that record shows that the sprinkler system functioned 96% efficiently in those many thousands of fires—a very favorable record, a better record perhaps than could be attributed to any other industrial device.

The four per cent of failures was largely due to the water being shut off by employees or by gross negligence in the maintenance of the system. It is imperative that sprinkler systems be constantly and properly maintained, that valves be kept open, that the water supply be adequate.

> **You can't in an emergency situation depend entirely on municipal water mains. The experience in England was that the water system went out very early in the intensive bombing raids, and the plants that had a local graft tank or local pressure tank or some other method of water supply were the ones that were best off.**

Above all, I hope that everyone here will remember the fact that the sprinklers must be given the opportunity to do the job. In case after case of bad-loss fires in industry that we get into our office, the underlying trouble was that somebody shut off the system before the fire was out.

Leave that to the fire-fighting forces. They're competent; they understand what to do. If there's a serious fire in a plant, let them decide; don't rush around and shut off the sprinkler valve. We have had case after case of disastrous fires because of that failure.

Another important phase of private fire protection equipment in a plant is, of course, a proper alarm service. Any good watch service with proper training is another fundamental essential.

> **Don't use, as so many plants do, the oldest and dumbest employees for watchmen. They are people who have responsibility for the protection of that property more of the time than anybody else, including the heads of the plant; and don't overlook the fact that the watchman's job today, because of possible sabotage and because of the emergency, is much more important even than at any time previously.**

The use of first-aid fire-fighting equipment is not fully appreciated—the use of fire extinguishers that will knock down most of the incipient fires before the fire department or sprinkler system gets into action. And one of the things that I am supposed to do in this talk is to make a few observations about fire-extinguishing equipment, for industries particularly.

There are no universal extinguishers that you can purchase and install in your plants that will be the answer to every sort of fire; and it is, therefore, important that you have the right type of fire-extinguishing equipment and that the men in the plant who have to operate that equipment when fires occur know the fundamentals, so that they will not use the wrong type on the wrong fire.

It's relatively easy to understand the simple principles of first-aid fire-extinguishing equipment. There are three general classes of fires into which extinguishers are classed. The Class "A" fire is a fire in ordinary combustible material, such as wood or paper; and for that type of fire the soda-acid type of extinguisher, a pump tank, or any other extinguisher using water as a medium, the antifreeze type, using calcium chloride to keep the extinguisher from freezing —those are the common types of extinguishers for the ordinary combustible material.

Class "B" fire is a fire in any sort of flamboyant liquid, and for that type of fire the most effective extinguishers are foam or carbon tetrachloride in the case of small fires, or carbon dioxide, the snow type or gas type of extinguishers, or the dry-powder type.

Class "C"—electrical fires of all kinds where the extinguishing liquid must be a nonconductor in order to safeguard the person who is operating it. That should be a carbon dioxide, a dry-powder, or a carbon tetrachloride type of extinguisher.

If you will remember those three classifications and remember to decide what types of extinguishers to have available to meet those hazards, you can't go far wrong.

It would, of course, be impossible to get into a discussion of the private fire protection equipment necessary for meeting special industrial hazards that develop in many industrial plants, but there are such equipments available.

Your fire departments and your insurance consultants will know about them. They can advise you about them, and it's pretty essential that you get competent advice for installing special equipment to meet a special situation in any property.

And finally **the fifth point in a program of industrial fire protection is the importance of having in any plant a well-trained and well-organized body of employees to serve as a private fire brigade.**

One of the other things that the Defense Council in my State of Massachusetts is doing and which seems to me as effective and as important as anything that this Defense Council is doing is to attempt to set up, see that there is set up in every industrial establishment in the State of Massachusetts, an employee fire brigade organization, properly trained and properly selected to handle that job.

Let me impress upon you the fact that there is no lack of published information about any of these matters that I have been discussing.

The National Fire Protection Association, and you can address us in Boston, is a clearing house of information. We are at the service of anybody who wants information about any sort of fire problem. You can get similar information from your insurance council. You can get it from your local fire department. They are glad to give it to you.

There is such information available that there is no excuse today, as I see it, for any industrial management to say that they failed to take care of a situation, firewise, in their plant because of lack of knowledge. The knowledge is available.

QUESTIONS

Q. Due to the coal strike, they have been storing a lot of coal, and this forms combustion. **What would be the proper method to prevent this combustion and also the proper method to put it out in case you get it in a coal fire?**

A. Soft coal particularly will ignite spontaneously — certain types of it with high sulphur contents—and we have had many instances of bad fires in coal piles. There are various methods that can be taken. I know of cases where coal has been stored under water, and that's a relatively common method.

Another thing is to put some sort of thermophiles or equipment into the coal piles so that you can catch any development of temperature increase; and the minute that any such temperature increases shows up, dig over the pile.

The digging over of coal piles that develop heat pockets is about the only method you can employ. If you have to have a big pile in one place, and it's a type of coal that is known to ignite spontaneously, the Bureau of Mines, I think, will analyze any coal in any storage for anybody and tell the persons storing the coal whether that coal is subject to spontaneous ignition or not. If it is, see that it's dug over and the position of the coal is changed periodically. That is about the only practical method.

Q. Will you repeat the type of extinguishers accessible for electrical fires?

A. The common type of extinguishers are: carbon tetrachloride—that's the vaporizing liquid type—carbon dioxide, and the dry-powder type. By that I mean the type of extinguisher that expels a solid dry powder. Those are the commonest types of extinguishers. You should not use a water or foam type of extinguisher for electrical equipment.

AIR RAIDS IN ACTION

By CAPTAIN DONALD S. LEONARD

U. S. Office of Civilian Defense

As the Chairman indicated, the latter part of June, Mayor LaGuardia, as the United States Director if Civilian Defense, thought that it might be entirely fitting and proper for our Government to send a mission of so-called experts to England, persons representing the various phases of municipal and state governmental life, so that they could study civilian defense in England, and in turn our country then might gain by the experiences of England without going through the same trial and error methods that they were forced to go through there.

So this mission was duly appointed in the early part of July. We left by Pan-American clipper for Bermuda, the Azores, Lisbon, and finally to England.

Landing at the airport in England, we were quite impressed by the camouflage throughout the whole airport. Leaving LaGuardia Field and the Washington Airport, then coming over here and contrasting them to the camouflaged situation there, we were quite impressed by it.

Just briefly talking about the subject of camouflage, it isn't the same old-type camouflage we were familiar with during the last war, but the present type goes on the idea of painting trees on roofs, painting apartments on the street, and all that, so a plane overhead would think it was over a park or a series of apartment houses or something like that; and it is rather effective.

In fact, from several blocks away, looking even on the landscape over there, you'd think you were crossing towards some trees and some private homes rather than some industrial sections or airports.

Then we were also quite interested in the barrage blimps that were flying everywhere, over every civilian area. In Hyde Park one evening I decided to count them. I counted about 250 or 300 of them, and as they just melted back into the distance, I finally gave up.

Now you will recall at the beginning of the war the Germans used to do a lot of dive bombing with rather terrific and horrifying results. So the English concocted the scheme of putting up these barrage blimps. They are about thirty feet in length, unoccupied of course, cost about $700 to manufacture, and are suspended by a steel cable attached to a little motor on a truck down below. This motor is operated by **a** Waft, a women's auxiliary air force member.

They elevate the ballons from one to five thousand feet. The Germans will not get under those barrages, because if they do they tangle up in the steel cable with rather disastrous results. So they are taken up plenty high, and **it has prevented to a great degree dive bombing over there;** and the presence of these blimps has a great psychological effect on the British people.

We left the brilliantly lit inside of the Claridge Hotel to step out into the inky blackness of the English blackout over there. Now their blackout isn't the Kansas City variety where a gang of hoodlums go into a powerhouse and pull master switches and blacken a whole town out, including hospitals and operating rooms and so on.

They have lights everywhere in England. They merely drape over the windows so there is no light even from the outside. the street lamps are all lit rather faintly.

They have a hood over the lamps so the light is emitted downward toward the pavement and actually can't be seen from above more than two or three hundred feet.

Then the automobiles have the right headlamp blacked out with the exception of a three-inch cross on them, with about a quarter of an inch thickness to it, and a faint light is emitted from that. It has a little hood over it, and you can see that about a hundred feet away down the street.

The left headlamp has a visor control so the beam is deflected twenty or thirty feet ahead of the light of the automobile itself.

In one of those memorable raids over London, 500 German aircraft swooped down one afternoon, but the R. A. F. blasted 187 of them out of the sky, and all told during the Battle of Britain, 2,375 German planes were knocked down. This was more than Hitler could take, so he abandoned daylight raiding.

But there wasn't one single night from October of last year until May 10 of this year that the Germans didn't bomb and bomb heavily the metropolitan area of London, and it became such a commonplace event in the streets that the people used to kid about it when the raid was ten minutes late.

Now when cities are bombed, sundry bombs dropping furiously into a hellish conflagration, hundreds upon hundreds of water and gas mains bursting, and thousands upon thousands of persons rendered homeless, it is then too late for governmental services to think up and devise schemes to counteract the fiendish ingenuity of a godless enemy.

> **If plans had not been thought up well in advance in England, there is no question whatsoever but that the soul of England would have been crushed beyond redemption, beyond any point where the military forces could have rallied sufficient strength to stave off invasion and subsequent defeat.**

In all previous conflicts and notably the last war, nearly all of the burdens and risks were assumed by the military forces fighting overseas. That has not been the case in the current struggle. As far as England is concerned, nearly all of the burdens and risks have been borne by the entire civilian population—men, women, and children alike.

It was thought at first that civilians, undisciplined for warfare, untrained in defense, pitiless targets for enemy attack, must crumble up in a wholesale scheme. It was even thought there would be mass hysteria, but **there hasn't been one single case of mass hysteria thus far to date in England.** The morale of the people has been absolutely marvelous.

We talked with three Major Generals of the last war who very proudly showed us their corporal and sergeant chevrons in the Home Guard because they were too far advanced in years to get into military work. They didn't want a commission. They were delighted to do their bit.

Throughout all England, that's the thing that counts, not social position, but who is doing the most for his country in its time of peril, who is doing the greatest job for the king. That's what measures the man and woman of today in England.

Now on the twenty-ninth of last December, Hitler decided to bomb out the City of London. The City of London, as you know, is about a mile square. It's the heart, the Wall Street section, of the entire metropolitan area of London. So hundreds upon hundreds of bombers were sent over on the twenty-ninth of December.

They started their raids at full moon. Why at full moon? Because at full moon the tide of the Thames was at its lowest ebb. And why then? Because when the tide of the Thames was at its lowest, the pressure for water mains for fire-fighting purposes was at its lowest point.

So they sent hundreds and hundreds of bombers over, each one laden with incendiary bombs. Each bomber carried one thousand, and they started raining them down until it was a veritable red rainstorm over there. And when these incendiary bombs came through the slate roof of a home, they'd penetrate down through the attic, down through to the living room, kitchen, or dining room, and in short while the whole room would be aflame.

The English Government has found it necessary to train every householder in the use of the stirrup pump. I won't go into detail, as you are quite familiar with it. **But had they not been taught how to use the stirrup pump, there is no question but that the whole metropolitan area of London would have burned.**

It is estimated that on the twenty-ninth and thirtieth of December last, one hundred thousand incendiary bombs alone were dropped. It took off a whole eight-block area in the City of London. The flames leapt sky high, and the brilliance of the flame was so great that miles away people in the streets were reading their newspapers by the light of the flames.

Then, of course, they came in with other bombers, hundreds of them, and this time they did not have incendiary bombs, but started to drop high explosives, ranging from 250 pounds to two ton land mines—four thousand pounds of concentrated TNT.

In order to help the fire services, 25,000 auxiliary firemen were called out to combat those flames; and in addition to the resources from the metropolitan area of London itself sent out into the City of London, they asked for apparatus which was sent from cities fifty, sixty, and seventy miles away; and in some instances they even came in with hand-operated apparatus.

They worked all that night and into the next night and succeeded in holding those flames in that eight-block area. But after these bombs came down, gas mains were ruptured, water mains broken, so the firemen had feeble jets with which to fight the flames. They ran across the mud flats of the Thames hip deep in it, drew the water up into their pumpers, and kept right on working.

That's what they have had to face over there, and they are doing a marvelous job of it.

> **You'll find static water supplies all over England, because in the event water mains are ruptured and broken, they must have static supplies of water so they will not be dependent on the mains bringing water to the fire apparatus.**

During all this time, the police officer and the civilian defense worker is out there doing his job of rescue while these high explosives are coming down.

Let me tell you when one of those two-ton mines drops—it used to be a sea mine they put out to sink boats with until they began demagnetizing the mine. The Germans had hundreds of them in storage in Germany, and one of their aviators concocted the idea of putting a device on a parachute, taking it over England, and dropping it over there with a delayed action to it.

And when one of these bombs comes down in a city area, it will flatten a whole block right out, completely ruin the buildings for a block around, and for a half mile and sometimes a mile away the blast effect is so great that it will take glass out of a window and hurl it through the air in a horizontal position.

> **There are many, many cases over there where glass will catch a person in the neck and completely decapitate that person.**

We talked with a widow in Bristol who had had the horrifying experience of seeing the glass from a window hit her husband in the neck, completely decapitating him in front of his wife and children.

They have had to develop means of counteracting that. They have taken cheesecloth glued with a glue that doesn't become too brittle, glued that cheesecloth to the inside of the window, and taken chicken wire or mesh and nailed that around the inside of the frame, so that it will fall against the wire mesh.

The raids started between ten o'clock and midnight and lasted for five hours every single night for seven consecutive nights. Now within a half hour after the fall of the first bomb, the lights and communications in the control center went completely out.

The control center is a nerve center from which all rescue squads and relief squads are despatched from their depots to bombing incidents, and it's absolutely imperative and necessary that the control center be kept intact. So the alternate for electric wire failure was kerosene hurricane lamps.

The alternate for communication failure was the use of sixteen and eighteen-year old high school boys and girls with bicycles and motorcycles who would take messages from the control center to fire, police, and A. R. P. depot officers, to the bombing incidents and return.

In the raids which lasted a week, 3,500 homes were completely ruined, blasted right out, of no value for any purpose whatsoever. In addition to that, 11,500 homes were partially destroyed. This makes a total of 15,000 out of 17,000 homes that were damaged as a result of enemy air attack.

Eighty out of 240 retail stores were blasted out. All of the bridges going over the river into the town were destroyed. All of the main trunk lines going in were also ruined. The A. R. P. mortuary was blown up. The A. R. P. mortuary is the place where they take the dead people for the purpose of identification. In many instances, the clothing has been blown off the person, or they are in such a damaged condition that identification is almost impossible.

For that reason, our Mission, when we returned to the United States, recommended that the entire civilian population of the United States be fingerprinted, because this would be a fine thing whether we have war or whether we don't have war.

And in England, where fingerprinting originated, they haven't done that as yet, and they realize this is one of their terrible mistakes.

There were twenty thousand people rendered homeless. These homeless are usually taken out to the rest center. They had moving vans operated by the constables picking up the homeless and taking them to outside areas.

In England they have made mutual-aid pacts between outside municipalities because they realize that enemy raiders do not recognize boundary lines, and they have to predicate their whole defense scheme on the same thesis.

What did labor do? Labor came in by the hundreds into that borough. They said, "What job do you want us to do?" They stayed there for ten days, taking their chances on food and lodging along with the rest of the homeless people.

Labor in England realizes that if Hitler wins the war, the cause of true labor goes out the window; and that's something that labor must be made to realize in this country; or we might as well give up our defense effort at the present time right now.

The army rolled in twenty-five canteens. Women volunteers manned them, along with army cooks. A ton of corned beef was served in the first meal, and 39,000 meals were served every single day for the next ten days.

Now that gives you an idea of the vast magnitude of the task over there; and in order to meet all these situations, in the City of London alone there are 186,000 persons engaged in A. R. P. work, and everyone of them, with 19,000 persons forming a paid nucleus, are volunteers.

And throughout England, **there are over one million engaged in civilian defense, entirely separate from the Home Guard and the military forces.** And in addition to that, there are 600,000 auxiliary policemen and firemen. And the working part women have played over there has been marvelous. They have joined the army, and they are in for the duration of the war, uniformed, and doing their bit.

I went over to one of the huge industrial areas there and went through the factory. I want to briefly go through an accounting of what occurred while I was there and my impressions of it. In the first place, as I neared this factory, I was stopped by a Home Guard, tin helmet, gas mask, and all that. They have these pill boxes, which are bullet proof, of especially constructed concrete, and they eye everybody going into the plant.

Now the plant itself, of course, was completely camouflaged, and during the daytime it would be rather difficult to tell just what was below the airplane, especially when they had to stay up some 5,000 feet or so above the level of barrage blimps. Throughout the entire plant were baffle walls, about eighteen inches thick, made of concrete or brick, and placed three or four feet in front of the doorway. It's placed there so that in the event land mines or bombs land in the vicinity the blast effect will shove up against that wall instead of the tearing the doors off and killing or injuring the occupants inside the room.

Going through the plant on a tour, the first thing I asked about was the evacuation scheme. I found prior to the war and in the early days they dug a lot of shelters back in the rear of the factory, 160 of them, holding from 100, 150, or so in each shelter.

They found when the air raid siren was blown, it took quite a little while to evacuate the persons back there; **so they devised colors, somewhat like our subway systems here. Each person in the plant was given a little chart showing the color scheme.**

If we were all engaged in operating machinery on this side of the plant, we might be in the purple section. Looking up at the pillars and sides of the room, you'd find big daubs of purple paint everywhere; so in case there was an air raid siren, all you'd have to do would be look up to see what the color was; then you'd find a purple sidewalk, go down a purple aisle, and find your way to the purple shelter. There would be no confusion. Over here it might be red or yellow, and the people would all go along their channels into their own shelters.

> **Otherwise, you might herd too many people in one shelter, and there would be confusion out there.**

In the event a messenger or someone like that was walking from one end of the plant to the other and an air raid siren was blown, he wouldn't have to return all the way; he'd just look up, see what color he was in, and go down and sit in there with the rest of them, because they have enough reserve seats to take care of stragglers like that.

They found they lost a little bit of time when they had air raid warnings where no bombs were dropped. They might have eight or nine during the nighttime, and it would take them a little while to get out in the shelters; and they might be there an hour before the all-clear siren went, and production was being held up.

Churchill in a patriotic appeal to workmen over there explained the situation to them, and they responded by saying, "All right. We will not quit work when the siren is sounded," although they are legally entitled to.

So they put spotters up on the roof with special controls attached to whistles within the factory; and **even though the whole town is alert and even though bombs are being dropped in the town, they remain right at work there in their blacked out factory,** until the spotters overhead see the planes coming on top of the plant, and if it appears that the plant is their particular target, they will sound three pipes, which means that the plant is the target and the workmen are to run to shelter.

> **They have some shelters now constructed underneath the plant and holes in the floors so that they can literally high-dive through those holes and down into the shelters.**

They have abandoned this system of shelters at the rear of the plants themselves. They have also found a very good substitute for shelters is the construction of a brick or concrete wall about three or four feet from the outside wall, so people merely have to run to the wall, duck in, and they are very safe, especially when you realize that nowhere in England do they attempt to build up against a direct hit.

All they try to do is protect civilians from blast effect, falling debris, and if that is the case, people running in between two walls would be just as safe as anyone else.

You might also want to know that the machinery located in the plant seems to have a sort of deadening and blocking effect for bombs dropping in there, because many laborers now, in case of bombs, merely fall behind heavy machinery, and they find they are just as safe there as anywhere else, because the machinery is very seldom dislocated or dislodged.

In building up their fire defense in the factory before war was declared and during their preparatory period, they had to get those extra nozzles, extra pumpers, and all that, and completely double their fire-fighting equipment in every factory over there, and they recommend that we get on our horse as far as that particular program is concerned, because their fire department must be able to function in the plant without expecting outside aid from the borough or municipality, because they may have their hands full fighting other fires.

> **They have stirrup pumps and sandbags throughout the entire factory, and the most effective way of stopping an incendiary bomb is merely to drop a sandbag over it and let it stay where it is.**

They have fire watchers, roof watchers, static water supplies throughout the interior. A picked crowd of laborers was given the task to start making oilskins for the personnel in the factory engaged in A. R. P. work. They have their gas masks, they have their bleaching creams, they have separate places where they can take men and women, put them through lockers, give them lukewarm showers, hot showers, cold showers, and then give them this bleaching cream.

When gas is used and a person is contaminated, if that person even touches another one, the second person becomes contaminated. **They have had to develop schemes of decontaminating people.** The rescue men go out in their oilcloth coats and pick them up. Before they get into the shower itself, they have a certain procedure to go through. They take off the hat, the outer garments, the coat, the shirt, the trousers, and last, the underwear, shoes, and socks.

Then the people sitting on the bench merely swivel on to the other side of the bench, and then walk into the shower. That's a clean area. The one side of the bench is contaminated. Then finally they leave the shower rooms. So they have to have clothes for all those people. That is another job they have had to do—build up clothing for their entire civilian population, and the factories have it for their factory personnel over there.

In the blackout, they have found the best way of providing a sure blackout is by the absolute removal of all glass. Lever Brothers have draped out and blacked out and trapped out light from going in and are getting along fairly well with it.

> **At the Ford factory they have decided against that and have removed every single bit of glass and put these thin sheets of metal of some sort or other in. They find they do a better job, and they haven't the danger of glass splintering.**

I have talked about the cheesecloth and screening that they use when they do have glass. Then each factory has found it necessary to develop a complete communication system, a control center, and rescue squads located around the plant. The roof watchers have to have cables going into the control center, and it comes in by alternate means, so if bombs knock out one set of lines, they still have the system, because they have three or four alternate supplies coming in, communicating with local telephone exchanges, so in case their service goes out, they will be on a priority list and will have their services repaired shortly after the police and fire equipment is put in order.

They have antiaircraft batteries up on the roof. They are operated by Home Guards, and they are given instructions not to fire at an approaching plane until they get an order from a group or fighter command. The only exception is in the event a plane comes overhead and actually starts dropping bombs; otherwise, they might shoot up at some of their own planes.

> **They have the theory of dispersal all over England. They wouldn't have one tank of oil, they wouldn't have one huge coal pile or lumber pile, such as we see around our industrial establishments, but they will take one pile of coal and make a dozen piles out of that, so in case of incendiaries, you wouldn't lose the whole coal pile at once. They have alternates for everything.**

At the beginning of things, in fact in July 1938, each of the factories over there sent in representatives of their service or plant protection departments to the home office for special training, and they went all through that. They came back and spread the gospel around their own plants.

In this one plant we visited, there was a decontamination squad of six men for each shift, a rescue squad of eight men for each shift, fire wafts of forty-nine men for each shift, six first-aid squads of four men for each shift, wardens and gas detectors, twenty-five men for each shift. They had their fire brigade established, their rescue and decontamination squads, all ready to function.

Everyone had been trained in first aid. Ambulances were stationed around the plant, spotters were on the roof, blackout completely thought over, and all plans made. Then they had to organize bomb disposal squads. An unexploded bomb landing in a factory lowers production more than a bomb that explodes, because when there is an unexploded bomb, you have to evacuate immediately, and you can't come back to work until that bomb is finally removed or until it has exploded. So they send in certain persons there to get lessons from the military and naval forces on how to delouse these unexploded bombs.

The Home Guard Unit in this plant alone was 500 strong. These people were in uniform, but they worked all during the day on the regular machines, and they only assumed their battle positions when there was imminent danger of some sort.

When there is an invasion threat, they take certain battle positions then, but there were 500 volunteers in the Home Guard, equipped with light Lewis guns, automatic guns, Tommy guns, machine guns, sixty-five rifles, one thousand hand grenades, and that was just for the protection of that one factory alone. That's to protect it in case of an invasion.

There were 445 air raid warnings in that one plant alone since the beginning of the war. The plant has been hit by six or seven antiaircraft shells, two oil bombs, one parachute mine, eight high explosives, and any number of incendiary bombs. They don't count them any more. In addition to this, nine land mines and 125 high explosive bombs have fallen around the plant property, but not on the plant itself.

On one night in last September alone, 157 incendiary bombs fell on the plant, causing 47 separate fires at about the same time, and the remarkable thing is there was very little damage that night, because these fire watchers went over and knocked them off in no time. Nine people were killed and forty injured all told. They have a logbook in which everything pertaining to the raid is entered, and the morale of labor has been absolutely marvelous over there.

Two thousand women employees were put in by the Ministry of Labor. They didn't know how they would act, but when the bombs came down, the men started to run for the shelters. The women stayed where they were and cried after the men, "Yellow belly, yellow belly," and made the men come right back to work. So have no fear in case women have to take part in this whole thing.

Then the most recent development has been the use of smudge controller smoke.

They found out by putting smudge devices around the plants, for maybe a six or eight-mile area, they can completely blacken out that whole industrial section with smoke so bombers overhead cannot tell what is underneath the smoke at all.

All of the information on industrial raids goes into the local control center, the region control center, and finally to the War Room of the Home Office, so every morning at eight o'clock they in the War Room are able to give the different ministers there and council members a true picture of the damage to plants. If one is knocked out, they can take labor from that plant and transfer it to another.

They have done a marvelous job over there. I'd like to read an actual account of the bombs falling there, but it's rather lengthy.

I want to congratulate you, Mr. Chairman, on the very splendid turnout here. This is absolutely the finest industrial meeting that I know of that has been held thus far in the country today, and it's only by the interest of you people and your alertness to the danger and your ability to organize in your own plants that we're going to meet the menace here and be able to come out on top of everything.

QUESTIONS

Q. What height are these walls around the plants?

A. They go to about eight feet in height. As long as it's actually over the head of the person, that's all that is necessary, because it acts as a buffer in case bombs come down. They run around seven or eight feet in height.

Q. Has gas been used at any time in this war against the English?

A. No gas has been used thus far in the war, but they have to be ready for it, and they have to have all their decontamination squads ready, because they never know at what moment it may be released. They expect it over in England and say they are ready to dump a little bit over in Germany.

Q. How about emergency lighting in a plant?

A. They have alternate lighting equipment there in the way of Diesel machines operating generators, so in case the regular commercial lines go down, they can switch over to their Diesels and operate their current for the essential communication services in the plant itself; and in many instances they have it built up so much that it can take over the complete load for the factory operation all the way through. Around the motors and generators in the powerhouses, they have also built these baffle walls, so they won't be harmed in case a blast lands in the powerhouse.

Q. Are smoke pots taking the place of other forms of camouflage?

A. No, they are in addition to that. This is the latest thing they are trying over there, and it hasn't been developed to such a great extent.

Q. At Harrisburg you made a brief mention of the care of schoolchildren. Would you make a statement to this group as to some of the special work done in order to protect the children?

A. Well, on the whole, the teachers have all been given first-aid instruction and have all been trained by the local police and also the superintendent of the school system in the plans of evacuation. In London alone, 700,000 children were evacuated within a period of a very few days, and the police force and school teachers and all of those agencies of the municipality got together in that evacuation scheme; but they're merely training their first-aid evacuation, and look after food in case it is necessary in emergency work for children over there. They have done a great job, too.

Q. Do they provide shelters for them on the school grounds?

A. Yes. They have shelters for the children at the rear of the school and special shelters out in the streets themselves. The most popular place for shelter is right in the middle of a street or along the curb, and it's a brick wall about eighteen inches thick, merely put there to counteract blast effect.

In England, I think this point is an important one, they like dispersal of shelters rather than concentration of people in shelters. They'd rather have ten people apiece in twenty shelters than two hundred people in one shelter. That's why they like the Anderson type of shelter behind the home where the family can get down there.

Unfortunately, in winter time it is rather difficult to take people back in the shelters. Some would rather stay in bed and take a chance on a bomb. The latest is a Morrison Shelter, named after the Home Secretary over there, and it's merely a steel table about as wide as a mattress, has thick legs and a thick top.

They put that in the concrete basement, and people will sleep under that at night. It's strong enough to hold the whole debris load of a home coming down on top of it. They are trapped, of course, but the Civilian Defense personnel will come around and take them out of the wreckage. They're safe enough.

They have priority of service over in England, priority of rescue service, because people under debris do not get the same priority of service as people trapped under debris and wreckage with a fire bursting in the distance and flames carrying the fire their way, or a water main knocked out in the basement that will flood them out like rats. They get the highest priority of rescue service.

Q. Do the Germans ever attack the balloons, and if so, wouldn't it cause great confusion?

A. They have had some damage caused by these planes getting off their mooring and the heavy cable going across wires, although most of the wires are buried cable, so they wouldn't have the same difficulty we'd have here, but they have had some damage caused when the balloons would come down with the cable; but they figure the safety feature more than counteracts the isolated cases of damage they have had over there.

Q. In sounding a raid alarm over there, what type of alarm signal do they use?

A. They use a wailing type of siren, and they control them by separate switches instead of a master switch. Throughout London they have the sirens controlled by the police on the streets who get the air raid red directly from their precinct stations rather than by a master switch, because if that goes off, then you can't put your signal on.

They have had trouble with some sirens in cold weather, because the sirens would stick when it got cold. They are still experimenting with sirens over there. Generally, the siren over there is an electrical siren that has a wailing, intermittent sound. A constant sound denotes "all clear."

Q. How about industrial plants? Do they just pick their own type of siren?

A. The siren is uniform throughout a borough because they want everyone to know what is meant by that. When a factory puts an alert within an alert, then they use their own signaling device, usually a whistle.

EMERGENCY COMMUNICATIONS

By HERBERT A. FRIEDE

Superintendent of Fire Alarms, Washington, D. C.

Communications are one of the most important phases of the entire defense setup. As has been outlined here to you today by previous speakers, without a communication network, your efforts may fail. It will enter into every phase and every unit, from air raid wardens to your plants and so forth; and to date, very little consideration has been given to the communication setup, except in a small way in various units of the emergency program.

In Washington, the commissioners of the District of Columbia set up a defense organization similar to that which has been set up in every state in the United States at the request of Mayor LaGuardia. We do not have any large industrial plants. We have some manufacturing plants, but our manufacturing plants are mostly large Government buildings which we have to protect.

So when our air raid warden service, our auxiliary police and auxiliary fire services, our manufacturing agencies and defense agencies were set up in these large Government buildings, which would be similar in every respect to the program which you will be called upon to organize, we found out that we had to think about this communications problem.

We had read a lot of literature about the European practice, and, fortunately, we had been studying this problem for quite some time. The Commissioner called upon me, inasmuch as I had charge of all communications for the District of Columbia—telephonic communications, fire and police radio, and so forth—to advise him on what type of communications would be best suited to coordinate the activities of these various defense units.

I had been connected with the Fire Defense Committee previous to the organization of Mayor LaGuardia's Committee, so we had an opportunity over quite a period of time to study the European methods of communication. Now if you ladies and gentlemen will bear with me, I would like to outline to you the handicaps under which the English people had to work when this war struck them.

They did not enjoy the amount of communications that we have in this country and the facilities that the communication companies have in this country. **All communications there were government controlled.** All communication circuits were controlled by the government, municipal as well as commercial telephone exchanges, as you know them today in this country.

So when this blitz struck London, their entire communication system, of course, went out. Then they began to decentralize. They built then what the British term "control centers," and from that control center, as these previous speakers have outlined to you, emanates all the intelligence which is handed down from the military forces.

And that's what you will have to depend upon for your communications—that particular building or buildings, whatever it might be.

I would like to make one other point clear to you gentlemen, before I enter into the particular phase of communication in which you are vitally interested, because industry must duplicate what the municipality has, only on a smaller scale.

Your communication facilities and setup will be identical to what the municipal area has.

The State Defense Councils are going to divide the states up into areas. In our particular area—and if you will bear with me when I say "our particular area," I am just trying to use that as an illustration to put my point before you—Washington, of course, is surrounded by Virginia and Maryland.

The metropolitan area takes in a strip of Maryland of two counties—Montgomery and Prince George County; on the other side of the Potomac River, Arlington County, Virginia, taking up Alexandria and all up through Arlington County. Those are thickly populated centers from which the people commute into Washington to work. Their homes are there, and for that reason we have to protect them.

Now each state will be divided up. Philadelphia will have its own city and its suburban areas to take care of. I don't know how the Governor or the Director in the State of Pennsylvania intends to divide up his state, but when that is done, then there will have to be established a control center, not only one, maybe two or three, from which must emanate all intelligence.

There has been a lot of confusion between the Aircraft Warning Service and the Civilian A. R. P., Air Raid Protection Service. The Aircraft Warning Service is strictly a military problem, and the facilities for bringing that intelligence from the aircraft spotters into the filter centers, the information centers, down to the control centers in the municipalities, have already been established and planned.

The Telephone Company, in cooperation with the Army, has done a splendid job. But then when they get down to the municipality—period! There hasn't been anything done. And, gentlemen, I have been in this communication business for a good many years in the fire department—and, incidentally, I started my career in the fire department in the State of Pennsylvania—and I know that **communications take time to plan and install; and I hope we don't wait until it's too late.**

I studied this problem for our own benefit, and I discovered that if we brought the Telephone Company in—take Philadelphia, for instance—and asked the Telephone Company to provide communication service or wire facilities for all your air raid services or air raid protection services in organization and industry in a city in this particular area, the cost would be astounding and prohibitive. It would never become an accomplishment.

And what would happen? What are you going to do with the air raid wardens, firemen, policemen, these auxiliary or safety departments? What are you going to do with these other organizations if you have no means of coordinating them? It would be like having a fire department without any means of calling them. The Telephone Company couldn't begin to furnish the facilities because the investment would bankrupt them. They could never amortize that investment. You men are all businessmen; you know what I am talking about.

All right. Then we have to analyze another situation, and nobody has given this thing any consideration. We have in the City of Philadelphia two communication bureaus from which the safety departments of this City are despatched. I am not so thoroughly familiar with the police as I am with the fire, and I'll speak about that just as a point of illustration.

We are going to enlarge the Fire Department; we are going to enlarge the Police Department. The City of Philadelphia has spent hundreds of thousands of dollars in maintaining and establishing a municipal communication system, and **it would be a foolish waste of public funds to try to duplicate those facilities or to eliminate them altogether.**

It's true they are for a specific purpose, but in an emergency and for the purpose for which they are intended, they could be utilized for the reporting of fires, incendiary and so forth. It's true they will have to be supplemented by additional facilities.

I have here a map which we plan for our own area. In there we intend to utilize every fire-alarm box and every police patrol box on the city streets.

> **We already have communication circuits established between the control center, which is the Fire Alarm Bureau in the City of Washington, and every Government building in Washington.**

We also in addition to that have a fire-alarm connection to every building—every one of our industrial plants—and right now we are enacting legislation that will make it compulsory for every building that is used for sleeping purposes of over 35,000 square foot area to have some type of connection to the municipal fire-alarm headquarters.

Communication facilities cost money. You are never going to get them any other way than by paying for them. You can either buy them outright and install them yourself, or you can rent them; but they are going to cost money.

> **In your plants, I think you should endeavor to determine what facilities you have available, and then provide alternate methods of communication to supplement what you already have.**

When I took this plan in, the Commissioner appointed me Chief of Communications for that whole metropolitan area of Washington. We made our own surveys, and we made recommendations to these various buildings as to the type of communications we felt they should have. We also provided facilities so that if our control center or our Fire Alarm Bureau was wiped out, we could decentralize and move over into another building. The cable facilities and all are in.

We couldn't operate probably as efficiently and as effectively as we do at the present time, but we would still be able to despatch equipment to the scene of any abnormal condition in the City of Washington and its metropolitan areas.

I also believe in every one of these units the man who has charge of that control center, the man who is in charge of your communication in any municipality, has a big responsibility to coordinate the activities of the municipality with the manufacturers and industrial plants of that community. Most all of the industrial plants are near some municipality that has a fire-fighting and police department.

We have protected every one of our schools in our area. We have connected those directly to the fire department, and immediately upon any abnormal condition occurring, the principal there in our training has been instructed to call the fire department.

Now I suppose you gentlemen will wonder why I am talking so much about the fire department. I believe that we must be sensible in this defense effort, and if we are going to have bombings, we are going to have fire.

Fire is your biggest enemy. If you have sabotage, fire is the easiest method. If your police and watchman systems function properly within your plants, as the previous speaker this morning told you, if you have competent men, you might keep them from committing acts of sabotage; but if they should break through the watchful eye of the police and a case of sabotage does occur, then you must have communication facilities available to call the fire-fighting forces into action quickly and as quickly as you possibly can.

The sooner you get them to the scene of these fires, the better off you are going to be and the smaller the fire is going to be, and you will have less lost time and loss of life.

Another thing that I might illustrate to you—in some of our large buildings which are comparable in every respect to your large industrial plants, we were faced with the problem, for instance, one of our buildings covers an area of four city blocks one way and four the other, and they have seven main entrances to that big building.

Originally we had only one means of communication, to the main entrance, and if the fire was any other place except there, the fire department would have to gather up and move, which entailed lost time; so we endeavored by means of the telegraph system to locate specifically the entrance to which the fire department should respond, and by doing that, we bring them right to the place and the scene of the fire.

And, gentlemen, the job we did there paid dividends, has paid dividends, because we have had no difficulty in five or six years that it has been in service, and we have not had any bad fires since we did that. We have kept them down to a minimum.

In closing, I would like to again urge you to have your communications man confer with the fire department and its communications man. I also urge you to help your municipal authorities to provide the facilities that are going to be needed and plan and get them installed now.

It takes time to put conduits underground. Whether you put them underground or on a pole, it takes time. It takes time to manufacture the lead cable. Copper is scarce and getting scarcer.

So I think these facilities should be planned, and every area, every defense director in the State of Pennsylvania, local director or whatever they might be called, should immediately consult with the municipal communications man and try to plan and provide adequate facilities.

And in the rural areas where those facilities and that service are not available, a local telephone engineer will be glad to render what service he can to you.

QUESTIONS

Q. Can you tell us anything about the use of radio in this general problem, any experience you may have had with it or would recommend?

A. In answering that, I might say that there has been no definite plan for the use of radio. Committees in the defense effort are working on that particular problem, and I think that our emergency radio will have a definite use as an alternate means of communication. We should depend entirely on wire facilities, because there may be times when the military forces might insist that you shut down radio broadcasting stations.

I might say, incidentally, in my own organization I have utilized my police radio and my fire department radio. I have also made plans for the utilization of amateurs, but I am using them as stand-by services to bridge the gap if and when the wire facilities should fail. I might say also that we ran some rather extensive tests on air raid warning devices, and we found that again we had to be reasonable and use a little judgment as to cost in order to keep down the cost of these installations. We tried sirens, but we found they conflicted with the fire department's use of sirens, so the siren was definitely out.

Otherwise, we'd have to abandon them on our police and fire department vehicles and other means for which they are now used. So we tried various other methods, and **we found that an air horn was the most economical, had the widest range of sound, and was the best suited for the purpose.**

We didn't provide air compressors for each and every unit; we merely provided the reservoir of tanks to give us a maximum capacity of one hundred fifty blasts at one and a half second intervals. We take two portable, gasoline-driven compressors and pump those up, and for our coverage we require nine.

They were very economical to install, because we installed them with our own municipal department by purchasing the tanks and the pipe, and we purchased the horn, and we made our own installation. We intend to install the rest just as soon as we think the need requires it, but for training purposes, we already have one installed, and we found that one-mile coverage was about the maximum that we could expect and be able to get sound penetration under all adverse conditions which these air horns would be subjected to. So if you were in this room, and there was one within this area, you would be able to distinctly hear that sound.

Of course, every city has connections with the central station service, and that is very fine. In lieu of anything else, that will render you splendid service; and we have several hundred such type connections to our private warehouses and such in existence. That will render an alarm quickly and accurately between the premises you are protecting and the fire-alarm central office, which is the control center as it is termed in British terminology, and the transmission of apparatus as quickly as you can get them on the job is the thing to do.

ARSON IN DEFENSE INDUSTRIES

By A. BRUCE BIELASKI
National Board of Fire Underwriters

I think that in any fire in a defense industry, you must have either organization or an accumulation of dangers.

We haven't found in peace time much arson in industries. The war-time situation brings about two conditions, one on the good side, that is better protection; and another, the added danger.

The most common dangers, I think, are physical. There's the hurry, the pressure to work at high speed; there's the crowding of facilities, of buildings with materials, and piling possibly inflammable stuff so as to interfere with firemen.

Then there's green help. That's always a hazard. New construction is one of the most serious hazards. Open fires, you know, are around. There's always something which can start a fire.

Then there is the availability of inflammables. They are likely to be more in quantity and more carelessly dealt with; but carelessness is the real problem.

There is the question of guards—the dangers, the human dangers. Guards are good, but the greatest lack, it seems to me, is intelligent direction of guards. It isn't enough to have an adequate number of men. Somebody must have supervision of them who knows what to do in given emergencies.

We have radicals to deal with. We have mental defectives. I have tried to keep in pretty close touch with every fire all over the country where there was any possibility of either sabotage or arson.

The saboteur has no better means of work than a fire, and I do not believe there has been any.

There has been one act of sabotage, I believe, but not fire, in the Martin Plant at Baltimore, which criminal case was recently concluded. We had an attempted fire in a large shoe factory in Massachusetts which makes shoes now only for the Army, Navy, and Marines.

It's an illustration of what to be on guard against. The fire was started under a wooden partition where everything else was stone or metal and couldn't have done any real serious harm. It was discovered before it got started at all. It was set up with a cigarette in the middle of a lot of matches, and the cigarette had not burned down far enough to ignite the matches.

The man who reported it was found to be, and recognized as such as soon as the Massachusetts State Inspector got there, a man who had been known as a pyromaniac in an adjoining county for some years. Of course, he was promptly discharged, but he never ought to have had an opportunity to start even what would not have been anything but an abortive fire.

I came by the Sloan-Blabon place, and it reminded me of the fact that there they had, just a couple of years ago, a series of six fires within a comparatively short time, all of them set by a man who had no grudge against his employers; he liked his employment, was satisfied with his wages, but was a pyromaniac and who wanted excitement only.

Those kinds of fires must be guarded against, and those kinds of people must be guarded against.

But I think with the protection that is now being given in most plants and the careful examination of who is employed, that possibility ought to, to a considerable degree, be offset.

In the last war, practically all the attempts at sabotage in this country were at the hands of nationals of enemy countries, and they were not men who had become a part of our citizenry at all. They were men who had been interned sailors on the merchant vessels of Germany and men who were caught here without ever having been a part of our life at all and had no way of getting away.

It was from those people that there were recruited the men who attempted most of the sabotage during the last war. I don't think that condition exists this time.

Our Government is much better prepared; more precautions have been taken; the laws are better. The Federal Government has an opportunity to do things which only the states had a right to do some twenty years ago. I think that situation is well in hand, but that is a possible source of arsonists.

The thing, it seems to me, which you would want to do in any given plant is to look the plant over and try to figure out how you would start an arson fire if you had that job to do.

If you don't have an organization, which means cooperation with some people on the inside, you must find some vulnerable point where you can get a real fire started. It's not likely, it seems to me, that that will be done from the inside. It must be done from the outside in all probability.

I think you should look over the adjacent places. Are they somewhere near your defense industry plant where a fire could be started with a reasonable prospect that it would extend to your plant?

Is the plant on water? Could a boat come up? Could oil be spread? Could a fire be started where it could get a real start and do real harm? Could a truck be brought in at night without inspection with an incendiary planted in it and so parked that a resultant fire would reach your factory or car shipments coming in in cars do the same thing?

Those are questions and similar ones which you must resolve by an inspection of each individual plant. So among the things which I think are important is that the receiving room as well as the shipping room in any large plant should be a separate, segregated place, so that you have the advantage of the time element, for fires cannot be delayed too long, and you have an opportunity to see whether there is anything in bulky material which will cause a fire without having it admitted to a vital spot in the plant.

> **When you find something in the way of an anticipated fire or arson case, or where you have a fire that you believe was incendiary, don't forget, because this happens to be a time of national emergency, that your first recourse should be to your own local people, your local fire marshal, your local police department, your state fire marshal.**

The City of Philadelphia has a fire marshal who has done fine work in eliminating hazards from homes, from industries, from public places of attendance. You have here in this State an excellent fire marshal force.

The Pennsylvania State Motor Police have a number of trained and experienced arson investigators who are doing and have been doing excellent jobs.

So, when you have a case of this kind, don't rush off immediately and holler for the F. B. I. or for the Army. **Take it up with your local men who by their training and experience will be better able to develop the actual facts, the physical facts, concerning the fire than men who have not been so trained.**

Those men, the minute there is any suggestion of enemy activity or motive directed against the interests of the Government, will call in the Federal authorities who are able to look at any case of this kind from a broader standpoint and know what it means perhaps in connection with other things which the local authorities couldn't know about.

I don't know anything more particularly that I can say, except that I believe we should remember that it's part of our job to keep up the citizen morale. We shouldn't rush out and holler sabotage or arson every time there's a fire, because the chances are neither is involved.

Keep cool. Keep your heads. Use the help that is available, and, above all things, do not let the fact that arson in defense industries is unlikely keep you from taking every possible precaution, for one serious fire might do a tremendous harm.

FIRE BRIGADES IN INDUSTRY

By ARTHUR W. ESPEY, Director, The Fire School,
Public Service Institute

The private, industrial fire brigade can well be considered as a highly desirable auxiliary fire fighting unit. Such a brigade, skilled in the techniques of Fire Prevention and Extinguishment, becomes a formidable adversary against the saboteur—and he knows it!

Even when normal productivity is commonplace, the plant fire brigade should pay its industrial owner big dividends. It should be no minor consideration in the matter of reduced insurance premiums. It should serve as a safeguard against the tardy detection of incipient fires which might rapidly assume conflagration proportions. As a guarantee of continuity of employment the industrial fire department should be a boon to both owner and employee.

Among some of the huge oil refineries and certain plants engaged in making chemicals or high explosives, may be found private fire brigades to whom the entire responsibility of fire protection and extinguishment is entrusted. Even the local fire department is not permitted to enter the premises. Obviously then, the peculiar fire hazards are most acute. They present problems which must be met by men scientifically trained to perceive and dispose of them.

Intricate systems of automatic fire detection are constantly supervised only by those who understand every phase of their operation. In that event, the municipal fire department, acknowledging the exceptional qualifications of the industrial brigade, stands by to assist only when a specific request to do so is forthcoming.

> Though a number of plants have fire brigades whose members are assigned to no other duties and are quartered in fire houses with elaborate apparatus, the vast majority depend upon a selected group of industrial fire fighters normally employed in varying occupations throughout the plant.

Generally speaking, the industrial fire brigade is not intended to supplant the regular municipal fire companies. It may be compared with the competent First-Aider who applies his knowledge to the benefit of some unfortunate victim—thus supplying the "bridge" between the scene of a sorry accident and the door of the hospital or physician. As a first aid fire fighting body, the efficient private brigade is often successful in holding in check or completely subduing a blaze prior to the arrival of the city fire companies.

Plant Fire Fighting Equipment

Before proceeding to my subject of the organization of industrial fire brigades may I briefly mention another essential—the industrial fire protective equipment. I am assuming that when an industry has in mind the formation of a fire protection brigade it has also taken steps to provide the proper equipment with which that group should work.

Most assuredly, a reliable fire alarm signalling system is paramount to safety. There should be direct communication between the private fire alarm system and that of the municipality. The plant watchmen should thoroughly understand the operation of both private and public fire alarm boxes. They should also fully comprehend the importance of immediately transmitting an alarm of fire before any attempt is made to subdue the fire. They should understand the importance of clear enunciation and explicit direction when transmitting an alarm by telephone. **Every employee of the plant should be likewise schooled in such important procedures.**

Together with the efficient signalling system there should be an ample water supply. Mains of sufficient size should be equipped with suitably gridironed branch feeds supplying hydrants liberally placed on and about the premises. If the source of water supply is a private one there should be provided the means of diverting the regular municipal water supply to the industrial system should this be necessary.

The proper type of sprinkler system should be installed. If the physical structure of a plant so warrants, standpipes too are of tremendous worth. Each, of course, should be equipped with Fire Department street connections and controlling valves on each floor. Standpipe hose, either on racks or reels, should be of the right amount to cover all emergency requirements.

In close proximity to each yard hydrant a hose cart carrying its quota of good quality rubber lined fire hose, coupled and ready for service, should be available. The housing structure should be conspicuously marked or painted, to identify its purpose. Within may be included extra hose nozzles, hydrant and spanner wrenches, a fire axe, possibly a crowbar, a short ladder, and in most cases, a suitable type of approved fire extinguisher.

Hand drawn chemical engines throughout the plant should be located at vantage points. In placing them, the consideration of specific needs is important. **It would not be wise to attempt to protect with a soda-acid chemical engine a risk that calls for foam protection.** Particularly important among those industries dealing with oils, greases and other viscous flammables is the use of foam generators, permanent foam discharging devices, and carbon dioxide systems of vital importance.

Water casks with stacked fire buckets, pails of sand and of water, and hand fire extinguishers are common protective devices found in most plants. The soda-acid, plain water, foam, vaporizing liquid, and CO_2 fire extinguishers are of tremendous worth in quelling small fires but each has its scope of usefulness. One type may serve effectively while another might be totally unsuited to the purpose.

In annalyzing specific fire requirements, care in selecting the proper kind of extinguisher to meet the conditions is mandatory. As it is true that the possibilities of freezing must be considered when a sprinkler system is to be installed, it is likewise necessary to think of fire extingiusher installations along the same lines. During severe weather, fire extinguishers in unheated buildings must either be fully protected against freezing or machines of the non-freezing class substituted for them.

Industrial Fire Brigade Organization

In organizing a private fire brigade for industrial protection, a thorough analysis of the job to be done must be combined with that of determining the men and facilities best fitted to the purpose. Of necessity, the size of the plant, the physical characteristics of the properties to be protected, and the nature of the plant processes must be studied.

Upon these surveys will depend the type and size industrial fire brigade required to serve best.

The Personnel Manager should have a fairly accurate picture of each man's capabilities. However, fire fighting is a task that requires something of a man that is not in everyone's possession. Therefore, in selecting the personnel of the brigade, persons indicating a natural interest in its activities, provided they qualify otherwise, are desirable. Men with mechanical experience, carpenters, plumbers, and electricians usually make good brigade firmen. Their knowledge of mechanics, of construction, and the intricacies of water and electrical conduits is of decided value. Unquestioned integrity, sobriety and common sense are necessary attributes to the character of every prospective selectee.

When making a choice of men for the various posts, much can be gained by bringing into consultation a seasoned fire department officer. Through an interview with the candidates this officer may readily determine the men best fitted. Such men have acquired an uncanny sense of human values and seldom err in their judgment.

Probably the most important choice would be that of the industrial brigade fire chief. It is preferable that he should be one who has had considerable actual fire fighting experience. He should be a keen student of the first service, comparatively young, in good physical condition, and quick to grasp the importance of his position without thought of personal ambition or ego. Subordinate officers of the brigade should be selected on the same basis.

In all cases, these men should have the ability to direct others. They should be tactful and calm and dependable to a fault.

The brigade chief or someone designated by him should act also as Fire Prevention Inspector. Aside from directing the fire prevention activities and assuming full command of the brigade, the chief should maintain a complete record of the fire fighting equipment of the plant, causing periodic inspections to be made to insure its efficient functioning. He should keep a record of the date and the hour that any piece of equipment was used and verify the fact that it is again in service for use.

Through the planning of its chief the men of the brigade should be periodically trained and from time to time assigned to such responsibilities as might better fit them for their jobs. **The program of fire prevention in which all employees of the plant should participate would be largely the result of the chief's creative instinct.**

Assisting him in all matters pertaining to fire protection, there should be a Fire Prevention Committee. Such a group might consist of such members as the Plant Superintendent; the Safety Director; the Personnel Director; the Plant Police Chief, should there be one; the Foreman of each of the plant's departments; and the Brigade Fire Chief.

If the industry boasts of a Safety Director, the Brigade Chief should perhaps be subordinated to him in an administrative capacity. **However, at the time of a plant fire, the authority of the industrial chief should be absolute pending the arrival of the municipal Fire Chief.**

For each floor of the plant or factory, and in the yard, a group of not less than six men should be assigned to the fire brigade. These men should be distributed at vantage points throughout the industrial area. They should be men whose ordinary occupations might be interrupted suddenly without serious danger or delay to the processes in which they are engaged. One of each group should be assigned as the Squad Captain; another as Lieutenant of the squad would act as aide to the Captain and assume command of the unit in the latter's absence.

Training of the Industrial Fire Brigade

The old adage, "Practice makes perfect," is as true applied to the industrial fire brigade as to any other following. In order that the members may individually and collectively improve their knowledge and performance, a well formulated training program is important.

A suitable room should be placed at their disposal where frequent instructive talks might be heard and discussed. Especially is it important to industries whose production involves hazardous processes such as machining alloyed metals of the magnesium variety that each employee—particularly the brigade members—be instructed concerning the possible reactions that sometimes, if not wisely handled, result disastrously. Similar enlightenment is essential to those who work, for example, in the rubber industries where volatile solvents offer something to worry about.

Qualified experts should regularly address the firemen of the brigade; the Chemistry of Fire, Dangerous Gases, Solids and Chemicals, and Manufacturing Hazards in Defense Industries being suitable titles for some of the lectures to be given.

Who, Why, When, How are interrogations that require authoritative answers and patient explanations. Each lecturer should appreciate this and make every effort to satisfy his listeners desire for enlightenment. When each employee has a distinct understanding of the specific fire dangers attendant upon the various modes of operation in the plant, henceforth he will regard them with respect. Likewise, understanding them, the brigade fire fighter should know the correct method of approach and the intelligent action required to control any fires originating therefrom.

To become thoroughly proficient in the operation of the plant's fire fighting equipment the brigade should systematically drill with it. By assuming a hypothetical condition and then simulating an attack with the appliances at hand is one medium of training. Another is repeated practices embodying the use of fire hose, fire extinguishers and such other paraphernalia as is provided.

An occasional test alarm from some fore-chosen alarm station in the plant should embrace all of the requirements of an actual summons to fight fire. The actual charging of hose lines attached to hydrants at selected points should serve not alone to acquaint the brigade men with the handling of hose and nozzles. From such practice may be reliably determined the efficiency of the fire stream and water supply, the condition of the equipment, and the promptness with which the men respond and get into action.

For the benefit of instruction a master map should be prepared. Thereon should be shown the distribution of the entire industrial system of water supply.

The location, size, capacity and pressure of mains and hydrants; the location of post indicators; shut-off valves and other component features of the sprinkler system; any auxiliary fire pumps or other water supply mediums, etc., etc., should be clearly indicated. On this map should also appear the fire alarm box locations throughout the plant.

Sometimes a master map of this description has a logical place in the plant's boiler room. It is here that may also be located the fire alarm visual indicator; master tape or some kind of central annunciator. Thus, when an alarm from any section of the plant has been transmitted, the plant engineer may communicate audible signals. These may be given out on the shop whistle or siren. In the absence of the engineer, the plant fireman would act. In performing such functions, these men would be assuming duties corresponding to those of a municipal fire alarm despatcher.

An important phase of the brigade's training deals with instruction pertaining to respiratory protection. **The use of gas masks should not be overlooked.** Certain industries have, besides silicosis hazards that demand the use of respirators, fume risks that might easily become acute—especially in the event of fire. Self-contained oxygen breathing apparatus and sometimes protective clothing are essential to personal safety.

Having to contend with dangerous risks, should a blaze require their services, the industrial fire brigadiers should be thoroughly versed in the use and care of this specialized equipment and its limitations.

First aid intruction should become a part of the routine training of the men. They should be taught how to recognize the several kinds of bleeding, the care and handling of the injured, the sensible treatment of scalding and burns. In fact they should know all the whys and wherefores of emergency treatment of any form of injury.

No less important than the features mentioned is the need to understand treatment of suspended animation. Whether the victim has been overcome by smoke or fumes, asphyxiated by gas, nearly drowned, electrically shocked, or suffocated in some other manner, knowledge of the recognized methods of resuscitation is essential. **The firemen too should be proficient in the operation of such supplementary devices as inhalators and resuscitators.**

Summing it up, the industrial fire brigade has a vital niche to fill in any plant protection program. Like its "big brother", the municipal fire department, it must be an expectancy organization. The unwritten obligation of the fire service requires that its members be prepared at all times to protect life and property.

QUESTIONS*

Following Talk by JOHN F. SEARS, Director, Philadelphia Office, F. B. I.

Q. Mr. Sears, with reference to fingerprinting, I am thinking that perhaps many employers think that their employees will resent it, and I'd like to get an expression of opinion from you on that phase. There is no doubt but that the time is here when something should be done.

A. The question of fingerprinting naturally is one for each individual plant to decide themselves. I might say that many of your large industrial organizations are fingerprinting today, the purpose being to give protection to the fellow-employee. Those fingerprint cards are not going to be kept in criminal records. There's a separate, particular type of blank for them. They are more similar to what we'd call a personal identification card. It's to identify the individual. The plant is not going to receive the criminal records. The Government has that information for the benefit of the Government in the event the wrong type of individual is employed in that particular concern.

I believe when we look at fingerprinting in the broad sense, it's nothing more than a means of identification. Unfortunately, fingerprinting was given to us by the criminologists; but when anyone says fingerprinting is putting us in the category of criminals, I say that every baby, the sweetest thing that is ever born, is fingerprinted and footprinted in any modern hospital today; and, therefore, fingerprinting is nothing more than to identify an individual. That's what is is used for. A man may change his name, but he can't change his prints. You are merely trying to identify employees; you are not putting them in criminal files.

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* Transcript of Mr. Sears' talk was not available.

Q. **I don't know how many employers will have to sell their employees on fingerprinting. It's got to come, and I thought it might be helpful to many employers here if you could give us a sales argument, and I think you have now, to the employee to make him willing, because they do feel that there is some reflection on them.**

A. I believe if you will discuss that with some of the men present here this morning who have fingerprinted, they can point out as we do that fingerprinting is nothing more than a positive means of identification. Let's say there is an industrial accident. Let's say the whole place is blown up tomorrow or next week.

Take the case that happened in Texas where those hundreds of schoolchildren were blown to death. These figures are a little rough, but I believe there were thirty-seven unidentified bodies. In other words, the parents went in there, and they were so badly mangled they could not identify any of them. It so happened the summer before nearly the whole student body had attended the Texas State Fair and had been fingerprinted by the Texas Highway Patrol. They got the prints from Austin, Texas, and positively identified every one of those individuals but three; and unfortunately those three had not been fingerprinted.

I could tell you history after history of a classic case in Pittsburgh where a man disappeared for fourteen years. He remarried. His wife had him declared legally dead. They collected on four insurance policies. The case came up before the Government. We put a stop against his fingerprints in Washington, D. C. He came up in California three years ago. It's just a means of identification. The criminologist does not depend on fingerprints to solve his crimes. He depends on fingerprints to have a complete social history when he walks into the courtroom.

Q. **Do you recommend the arming of guards?**

A. The arming of guards is a question which must be decided by the plant management in conjunction with the local laws of your state. We say that a guard should be adequately armed, whether he be adequately armed with a searchlight, a revolver, another patrolman, a watchdog—that question must be dicided.

Q. **In support of fingerprints as a means of identification, our organization through our Personnel Department has just completed 14,000 prints with two objections.**

A. Here's a sales argument. Baldwin Locomotive has just fingerprinted fourteen thousand employees, and they had only two objections.

CAMOUFLAGE AND BLACKOUTS

By MAJOR PETER RODYENKO, Corps of Engineers, Second Corps Area

When it comes to protective concealment, you perhaps might wonder why I am using this term instead of the more familiar term of camouflage. Well, some time ago the War Department very wisely declared that this term should be substituted for camouflage, the reason being that during the last war this term was invented, it appeared, for the French Army.

The activities relative to protective concealment were generally left to artists. In those days, little if anything was known. Only in the latter part of the war, shortly before the Armistice, were any attempts made to treat the subject scientifically.

Mainly it was a hit-and-miss affair, left to guesswork and experimentation; and while some of these artists did remarkably good work, the great majority of structures and ideas that were supplied did, to my mind, supply Rube Goldberg with inspiration for his masterpieces.

Well, protective concealment may be an art, but it is based on definitely established scientific facts, and I venture that it could be compared with the work of the plastic surgeon. Plastic surgery is an art, but the practitioner has to be a medical man first, for very obvious reasons.

Just so, an individual engaging in activities of protective concealment should be or must be technically trained. He must be familiar with the scientific facts and laws on which protective concealment is based.

Now when it comes to our particular activity, the majority of you gentlemen, I understand, are engineers and architects and other technically minded men; therefore, I hope I will be able to say a little and let you do the rest by your own thinking.

The activities of protective concealment can be well divided into two main classes. **First, the planning of new establishments, for the civilians, I mean; and second, what are we going to do with existing plants, factories, and other civilian establishments of importance?**

In Germany for over twelve years it became a very little-known regulation outside of Germany that any concern that was desirous of constructing a new plant had to submit the plans to a certain government agency for approval and for the inclusion of protective concealment features.

Thus the German Reich succeeded in making the practice of protective concealment universal. We have not the time to do that. We have not ten or more years to prepare.

Our problem is what to do with existing industrial establishments, and this, ladies and gentlemen, is the subject of my talk today.

We are no longer in a guessing, experimental stage. We still do experiment, but we are familiar now with the principles that govern protective concealment; hence, we refer to it as protective concealment and not camouflage any longer.

If we look at the basic principles governing protective concealment of existing establishments, we must ask ourselves first, what is the purpose of all this? The purpose, ladies and gentlemen, is to provide protection against detection on aerial photographs and protection against visual observation by bombardiers. In this particular case, there are two schools of thought: One, to my mind, based on emotion, and the other on plain logic.

While I have the most thorough admiration for the British nation and their very, very brave army, I must say that the British failed to be as thorough in their preparations as the Germans in that they attempted to provide protection only against the visual observation by a bombardier, who has to pick up his target approximately five minutes' or three minutes' flying time before he passes over the target.

Most of you have heard about the bombsights. Well, the bombsight is a certain complicated piece of machinery with dials that have to be set, and various variables that enter into bombing data have to be computed.

After the dials have been set and the lever has been released, then the bombsight will tilt automatically towards the ground, and at the correct moment, at least according to the data computed, will automatically release a bomb. Therefore, it is essential, of course, that the bombardier must pick up the target visually before he can set his bombsight. And the British reasoning is that this is about all that is needed.

The German method, built very much on logic, cold logic, admits the correctness of this theory, yet at the same time makes considerable effort to also provide protection against aerial photography preceding the mission trip of the bombardier. The Germans reason that it is a common practice not to send bombardiers out on a haphazard mission. In plain English, the bombardiers are not told to load their ships with bombs, fly around there, pick up targets, and then bomb them.

This is not done, but just as the course of a ship or a vessel is carefully laid out and then equally as carefully followed, so a course, also called a flight line, is laid out for the bombardier by means of maps and aerial photographs, previously obtained. The bombardier is shown aerial photographs and maps; he is shown the flight line, the course he is to follow, and he is told which target to bomb.

Now, reason the Germans, if protective concealment of an establishment has been conducted or executed in such a manner as to provide protection against aerial photography to such a measure that it cannot be spotted on an aerial photograph, the bombardier sent out to bomb this particular target starts out with a psychological handicap. He does no exactly know where the target is located.

He's merely told or shown that the target he is to destroy is located approximately here or there, but that he himself is supposed to pick it up through his bombsight.

You will realize, ladies and gentlemen, what important interference such a psychological handicap of uncertainty will have on the bombardier. I personally believe that **this method of providing protection not only against visual aerial observation by bombardiers, but also providing protection against aerial photography is very, very important—which has been proved.**

Well, the contention has been made that for several months no observation planes have been sighted over England. This is correct, but it must not be forgotten that every bombing ship or every bomber of any nation that can afford to keep bombers will carry in the tail turret an aerial photographic camera which is being used by the man who also serves as the tail turret machine gunner.

> **Aerial photographs are constantly taken. They serve as a score card for the bomber. Not only that, but upon the return of the bomber, they are carefully studied and compared to previously taken photographs.**

We also have reasons to believe, it isn't exactly confirmed, that the Germans nowadays carry two cameras in the tail turrets, one loaded with panchromatic film, and the other with infra-red film. While I do not feel inclined to overrate the importance of taking pictures by means of infra-red film, I merely wish to point it out.

There are certain important matters to be considered in protective concealment when it comes to infra-red. So much for the present.

Now, what methods do we use to provide protection? Before we speak of methods, I feel inclined to say just a few words about the basic principles of protective concealment, which, incidentally, haven't changed for thousands of years. Those basic principles are three.

> **One is concealment; another one is confusion of identity, and the third is the use of decoys or dummies.**

The explanation is rather simple. If you conceal something so well that it can't be seen, so well that it can't be spotted, then, of course, it can't be bombed.

Confusion of identity. If you take something, an objective or a target which is important and make it look unimportant, then it will be disregarded, overlooked, or neglected by an enemy.

When it comes to the case of dummies or decoys, if you set up something that looks like something else which it actually is not, place it in a logical site, and then make attempts to, let's call it, camouflage this decoy, but don't do it well enough so that it can be spotted, then the chances are the hostile observer will pick up this decoy, which attracts his attention, and will overlook the target which he should bomb.

Well, the methods generally used in protective concealment of industrial establishments are:

> **Blending into surrounding landscape, reduction of visibility, the distortion of shadows of the construction, the placement of decoys in conjunction with the disguise of landmarks.**

Sometimes an existing establishment can be blended into a surrounding landscape by various means, which I propose to show later on the slides. The reduction of visibility can be accomplished in a plant by construction and also by the discriminate use of paint combined with texture and the study of shadows.

The distortion of shadows can be carried out by changing the shape of the buildings by means of exercising or superstructures and extensions, dummy extensions; and decoys in conjunction with the disguise of landmarks are sometimes at least very simple to execute.

For instance, let us assume there is an important civilian establishment which in itself is rather hard to locate, especially after it has been concealed or treated; but if there is a church nearby with a tall, white steeple and a crossroads—points of bearing for the gunner or bomber—then something has to be done about this, too.

In such a case, for instance, the congregation of the church would have to be approached for permission to remove that steeple, for the time being, and a dummy church, a motion picture setting so to say, would have to be set up somewhere several miles away, so that the bombardier would be confused.

As regards the roads, dummy roads consisting of pieces of canvas, for instance, stapled down or pegged down in the fields, can be used for imitation roads, while the actual roads would have to be colored and textured so as to blend into the surrounding terrain.

The considerations to be followed when it comes to protective concealment of existing establishments are the following: The consultation of the local, designated authority in charge of protective concealment, contingent upon appointment of such an authority.

> **At this time, the Government, not the War Department, but the Government, has not as yet declared a policy as to who is to handle protective concealment for civilian installations nor instruction of civilians in this important activity.**

At this time, we really do not know whether the Army is going to handle it or some other to-be-established Federal agency, whether it is going to be handled by the Office of Civilian Defense, or whether it will be thrown into the lap of local committees, groups, or organizations.

At this time, **the Office of Civilian Defense, however, has the authority to request the War Department for assistance,** and this accounts for the fact that I am authorized to speak here, as a request had been made to the Army. The Army is willing to cooperate, but the Government as yet has not made any decision as to who in the future is going to handle protective concealment. Many of us do hope that this will be a matter entrusted to technicians and not politicians.

The second consideration is the securing of suitable aerial photographs of an establishment and surroundings. This is a very, very important matter which is frequently overlooked, as I hear, in other countries.

> **Aerial photographs should be taken, mind you, not only of the target, factory, or plants to be concealed, but also of its surroundings.**

When I say surroundings, I mean that oblique or panoramic pictures should be taken from four points of the compass at about ten minutes' flying time, if a ship is used that doesn't fly any faster than about 80 or 100 miles an hour. If a ship is used that flies faster than 200 miles an hour, then five minutes' flying time at an altitude of approximately 5,000 feet.

In addition to that, vertical photographs in stereoscopic pairs. That means overlapping pictures should be taken of that particular factory at an altitude of about 4,000 feet. Of course, we all realize that no bomber will dare to come down so low in times of war, but for the purpose of studying the problem on hand and preparing adequate protective concealment, it is necessary to take pictures at lower altitudes.

Frequently, you find it is also necessary to take single photographs at an altitude of about 1,500 feet, because, in the majority of cases, streoscopic, overlapping pictures cannot be taken because of low altitude. These photographs should be taken with panchromatic film, and, if possible, the pictures from lower altitudes should be taken in color, too.

Take them in black and white and color, but do not attempt to take aerial photographs at an altitude higher than 4,000 feet with ordinary kodachrome film because the pictures will show blue. We are now experimenting with a new kind of film that will be effective above altitudes of 5,000 feet; but this is still a little far off.

Third—planning of installations by experts, approved by local authority. At this time, gentlemen, I regret to say we haven't very many experts, but **I do hope before the year is over that we will have some in the Second Corps Area in New York.**

We have tried to give lectures—we haven't the authority to give courses, for the reason which I mentioned before as regards the policy which hasn't been settled yet—but as far as our authority goes, we are trying to interest technical men, especially engineers and architects, in protective concealment, hoping sincerely that before long we will have some people who know at least the basic principles, even if they haven't experience, which, however, has to come later on.

Supervision and inspection of projects by means of aerial photographs and aerial inspection. This, too, is very, very important.

I have seen repeatedly how protective concealment projects that were started very auspiciously ultimately failed because of the fact that progress had not been checked up from the air.

Mind you, it takes years of experience to be able to visualize what things look like when seen from the air; and unless check-ups by means of aerial photographs are made during the progress of the project, some very bad mistakes are liable to be made, which ultimately are liable to nullify the entire effort; hence, very frequent inspection, observation has to be made from the air. The photographs to be taken are of the same type mentioned before—vertical as well as oblique.

Another very important item is practicability. That means the cost has to be held down as much as possible. Therefore, one must know to what extent protection has to be provided; and one of the first things to be considered is the study of the local shadow sector.

We know that objects will cast shadows that in form, of course, have the same outline as the objects that cast the shadows, and an experienced reader of aerial photographs will by looking at the length of the shadows be able to tell you the actual height of the object that cast the shadow; not only the shape, mind you, but also the height. Therefore, the local shadow sector will have to be studied, and by means of a simple formula, the extent or length of the shadow can be predetermined.

> **The proportionate cost of installation has to be considered. If the cost of installing protective concealment approaches almost the value of the property, of the plant, then it certainly would not be advisable to do anything about it.**

This is a very important item. I have given the matter quite a bit of thought in the last few years, and I have come to the conclusion that **the total amount to be expended on a project shouldn't exceed ten per cent of the value of the actual objects to be concealed,** not of the entire plant, not including real estate value, of course.

If that maximum of ten per cent is observed, then distributing it over five years, it will come down to approximately two per cent per annum, which appears to be a reasonable figure. In Germany, I understand they allow more than that. They allow up to 25 per cent of the value.

The time element involved. If it comes to it that we have to provide protection for existing civilian establishments, which I am not in a position to decide, the time element will play an important role. This has to be taken into consideration by the individual who does the planning and designing; **hence, simplicity of design and simplicity of maintenance is very important.**

Just as at this time we have not many executives who are familiar with planning the design and the supervision of execution of concealment projects, so we haven't very many craftsmen who can do this work, and in the majority of cases, quite an amount of actual physical work will have to be done by maintenance crews; hence, not only the design has to be simple, but the maintenance has to be simplified.

> **Adaptation to seasonal changes is important. It goes without saying that at least twice a year a change would have to be made—in spring and in fall, of course.**

Freedom from identifying landmarks or their disguise. I believe I touched this particular item before when I mentioned that church with a steeple that had to be removed. Now, for instance, if you happen to have a body of water nearby, like a reservoir, in many cases it will be possible to cover up this reservoir by means of rafts and set up a dummy reservoir resembling a body of water at some distance. That can be done rather simply.

We found out the Germans have various methods of doing it. One is to use stainless steel in spots, broken glass, and in other cases to use a concrete mixture in which ground glass has been imbedded. I can't go into all these details, but there are very many ways and means to obtain such effects which will mislead an observer and also make it difficult to spot the target on an aerial photograph.

Then comes possible utilization in times of peace of those additional structures which have to be constructed to provide protection. Now in Germany, for instance, they used the rather practical method in cases where they couldn't afford to put certain factories underground, which is, of course, a very expensive sort of proposition, of grading the ground up to the highest point of the building and utilizing the ground underneath for additional storage space and so forth.

> **Now a clever designer of protective concealment structures can really not only provide adequate protection for actual bombing, but he can also produce additional space which can be utilized in times of peace by the concern involved.**

The elements of technique. I touched on the subject of shadows a short while ago, but we will go into detail to some extent on distortion of form. If you take an object that is shaped like a conventional building, by putting simple pieces of superstructure to it, you can distort its form and also distort the shadow it will cast. Distortion by extension can be accomplished by adding temporary structures of so-called motion picture setting type.

Then distortion by interpolation. If you want to distort shadows, in many cases you can accomplish a lot by the discriminate use of planting trees or by using trees that have been put into boxes on rows or wheels. We found the Germans, for instance, very successfully concealed air fields by having complete dummy houses, groups of houses, small groups of woods, and groves which moved out of the way.

In fact, it took the R. A. F. over a year to spot a certain air field in Germany, and it probably would never have been discovered if by mistake the Germans hadn't tried to move the houses and trees out of the way while an R. A. F. photographer was sitting at the camera. As it was, a succession of photographs were taken which showed that the whole village started to move.

Elimination of reflection plays a very important part. Reflectivity will have to be cut down. Of course, in many cases this is liable to interfere to some extent with the work. We are working on various things now. For instance, one is the use of nonreflective glass. Some time ago, I think it was Dr. Rhoads over in Pittsburgh who made experimentations as regards nonreflective glass that could be used in television. I personally, too, gave the matter of nonreflecting glass quite a bit of thought for the last five years, but I didn't get very far.

> **It appears that Dr. Rhoads has evidently found a solution by treating ordinary glass with a solution of hydrofluoric acid in water, one part fluoric acid with two hundred parts of water.**

By merely washing this solution over the glass, a very thin film is produced which cuts down the reflectivity of the glass, but doesn't interfere with its transparency. This is just one method. But, of course, there is one thing which I'd like to mention. There is absolutely no use even in blackouts in painting windows on the inside.

I have seen people who made an attempt in one of these blackouts which you see occasionally mentioned in the papers to paint the inside of the windows. It had the effect of not letting the light in, but at the same time it didn't cut down on the reflectivity. So if other methods have to be resorted to, opaque paint will have to be applied on the outside.

> **Control of lighting. This is a matter of organization discipline, and that's all there is to it.**

Elimination, disguise, and displacement of existing landmarks. I have mentioned before that this is a somewhat complicated affair and will require cooperation and coordination through a delegated authority. It appears logical that various authorities, municipal, county, or state, will be interested in that.

However, you see this is a matter where individualism will enter, and it will take considerable effort to induce counties, or municipalities, or individual owners to consent to certain temporary changes of their property. The important thing is to point out to them that in time of emergency certain sacrifices will have to be made.

The shape of pattern. Well, this becomes a little too technical to mention here. If we have a pattern of landscape, that means if we, for instance, have a target that is surrounded by geometric fields which are in the shape of an oblong or square, it would look a little different if all of a sudden a circle or an elliptic pattern were to be introduced.

Protective planting and landscaping is of great importance. It is almost incredible if I tell you that **a most excellent protective concealment job can be done with no other work than by using protective planting.** There again the selection of plant material is important. It's logical. It would be absurd, of course, to put up a group of deciduous trees in a terrain where only evergreens are found, and vice versa.

Then the coloring of plants by chemicals can be done. For instance, in trying to conceal an air field, which is quite a difficult job, in many cases very much can be done by the use of fertilizer or chemicals which will make certain plants grow in a different color.

We have found out that certain chemicals when used as fertilizer will change the color of grass. We have also found out that by spraying grass with certain chemicals, for instance, ferro-sulphide and tannic acid, that grass can be made to look almost bottle green, and, therefore, will photograph differently and look different. I don't want to go any further, but that just gives you an idea of what can be done.

Texturing by different types of planting. For instance, if you prepare a plan to lay the air field out in such a manner that it is divided into obliques, squares, or whatever fits in with the surrounding pattern, then have your lawnmower run in one field from north to south; then in the next field you let the grass grow as high as it will.

In the next field run the lawnmower from east to west; in the fourth you plant honeysuckle; on the fifth you use the mowing method again. So you can change an air field in such a manner that from the air it might resemble landscape fields, or you may turn it into a real estate development, and whatnot.

Seasonal and soil considerations are very important before plant material is to be selected. The Army has made a survey of all the plant material in nine corps areas and has a pretty good idea what plant materials, trees, bushes, and whatnot, are available, which also include native plants, not fancy plants.

Dummy trees and shrubs. Very often the use of actual natural trees is not advisable for technical reasons. Natural plants have to be maintained; hence, artificial trees and artificial rocks can be used to great advantage.

Now I mentioned protective coloring. I stated that color is effective only when combined with the study of shadows and with texture.

As regards texture, I mention now that texturing will have to be used considerably, because very often in the majority of cases artificial work, human handiwork, will reflect quite differently than natural plants and natural features; hence, human handiwork—buildings, roofs and walls, roads, fields, towns, air fields, runways—will have to be textured and colored, mainly textured, in such a manner as to blend in with the surrounding terrain.

The protective coloring is very important. Above all, we must know what colors, what paints, and other coatings are to be used, and considerable study is being made right now.

I'd like to mention that the Paint and Varnish Club of Philadelphia is doing splendid work. We also have the New York Paint and Varnish Production Club, and I must say this organization of paint chemists is doing marvelous work.

The method in which these paints are to be applied is another matter, of course. We have so-called disruptive painting, which has the purpose of breaking up regular outlines and making them look irregular. Then there is what is commonly called dazzle painting, which we consider more or less obsolete, except in a very few cases; and shading and countershading in such a manner that the colors that are used will blend in and form air matches as well as photographic matches with the surrounding terrain.

When I say "air match and photographic match," that means very frequently color or shadows which may appear matching to a human eye will not necessarily match when viewed under aerial photography. Therefore, this matter has to be given consideration, too.

Then there is the very important matter of providing protection by means of smoke. You know, of course, that smoke is by no means new in the Army and in the Navy. They have been using what are commonly called smoke screens. Generally white smoke is used, but it has been my contention for the last few years that to use white smoke for protective concealment, especially for industrial plants, it not advisable because of the fact that white smoke will draw the attention of the bomber and also will register on an aerial photograph.

You know, of course, that smoke will disperse after a while, and it can be safely assumed that the only time smoke will really be very dense is at the point of generation. Therefore, if we were to see a heavy cloud of white smoke, we could safely assume that our target was in very close vicinity to this heavy white smoke. Based on this assumption I began to experiment with colored smoke; and I do believe that if several colors, several kinds of colored smoke are used, for instance, brown, green, yellow, and black, an appropriate mixture of colored smoke can be obtained in such a manner that when viewed from the air, the object will be concealed, but the concealing smoke, by mixing the various colors, which can be done by placing smoke apparatus, will be concealed if the smoke that is used has the same colors that are found in the terrain.

Of course, it was rather difficult to do much experimenting because in the beginning sometimes the smokes were a little more toxic than I wished they were.

Now we can produce a large number of colored smokes which, if properly arranged and set off at the proper time, would be very effective and add to the concealment of the establishments.

Smokestacks are an awful headache to the technician who is trying to conceal a factory, because smokestacks are conspicuous, and they throw very heavy shadows. Occasionally, not in every case of course, by the use of micromizers and certain chemicals, smoke can be emitted from the smokestacks which will help to conceal them.

Another important item, of course, is the matter of general concealment features which concern communications. For instance, if a railroad is running alongside a factory, it is a pretty difficult job to conceal it. Conventional parking areas are a dead give-away.

Very much can be done by erecting structures over those parking spaces which will most effectively conceal the cars. I made experiments myself on a fairly large scale, and they proved to be very successful. We know the Germans have been doing that very extensively. The German workingmen don't use cars as much as ours, but you cannot spot the Germany factory by looking for siding communications.

The matter of ordinary smoke, steam, and flames has to be taken care of. Mind you, one of the most difficult things to take care of are steam jets coming out of factories, gas, smoke, and whatnot which can be spotted at an altitude of 35,000 feet. That is pretty high up; you have to use oxygen; nevertheless, you can spot this jet.

However, as I mentioned before, by means of colored smoke you can provide some means of protection, which to some extent will kill off the effect of the smoke. **Flames, of course, are another matter; especially at night, they are very conspicuous, and there is very little to do about it.**

Dummies and decoys. Well, it might interest you to know that in many cases the Germans when they found out they could not effectively conceal a factory actually set up dummy factories near there. Now that may sound like a very expensive sort of affair, but it is not, because there are very many ways and means. You can set up very flimsy structures. However, they are resistant and will withstand the weather and wind and will give an aspect of bona fide buildings.

Then, of course, concealment of activities connected with protective concealment.

> **It is a very important thing to plan one's work in protective concealment in such a manner that an observer, or enemy agent, or Fifth Columnist, doesn't exactly know what's going on; otherwise, we have reasons to believe that such activities will be reported.**

Well, these are some remarks which will give you an idea what protective concealment nowadays is based on. Protective concealment is not a cure-all, but if properly handled it will very effectively produce satisfactory results.

GAS DEFENSE AND DECONTAMINATION

By MAJOR WILLARD A. JOHNSTON, U. S. Army
Division of Chemical Warfare, Edgewood Arsenal, Md.

The words "poison gas" I think are repugnant to every American. We don't like the sound of gas; we have an inherent fear of gas, and there's always a feeling among most Americans that gas warfare is a most cruel and inhuman type of warfare.

Now I am not going to argue the advantages of one type of warfare over another. As fas ar I am concerned and as far as the majority of you are concerned, all types of warfare are inhuman. **I personally would rather get a dose of gas than I would to have a bayonet stuck in me and twisted around;** but every man to his own weapons. You choose the kind you like. I'll do the same, if I can.

The United States has in a number of meetings with other countries talked over the subject of gas warfare, and the usual result of those conferences was that no decisive step was made to outlaw gas warfare.

A great many persons think that gas warfare is a brand new idea in World War Two. The facts of the case are that gas has been used, at least chemical warfare has been used, in a great many cases. We have very good reason to believe that the Italians used gas against the Ethiopians. That is almost a proven fact.

We also have on high authority the information that the Japs have already used gas against the Chinese. Therefore, the use of gas is nothing brand new. It's with us, and **we can probably look forward to a spread of this use of gas.**

There are a number of chemical warfare agents. We have, of course, the poisonous, gaseous materials. We have smokes and incendiaries. The incendiaries have been discussed with you by Major Brayton, and our last speaker this morning mentioned the fact that smokes have been used for camouflage purposes, and they certainly have been used by all the armed forces in order to carry out some of their activities.

Smoke screens are very common. The Chemical Warfare Service does its very best to sell the idea of the use of smoke to other services in the Army, sometimes without the results we would like to get. The use of smoke is undoubtedly of great importance in the conduct of a modern war, with the fast moving of troops that is taking place.

The question comes up: Will Germany use gas? Of course your guess is as good as mine. My guess is, and I have stated this a number of times, that Germany will use gas as soon as she sees a chance to win by using gas. **I have always held the idea that the use of gas was a last step, the very last chance that a country had to win.**

Hitler undoubtedly realizes the fact that other countries can use gas as well as the Germans. Down at Edgewood Arsenal we have a very large manufacturing establishment. Gases are being made there, of course.

The United States is not asleep on this gas warfare, and we hope to be ready to play any part that is required in case gas is used.

The question has been asked as to who is going to use gas first, as to whether Russia shouldn't use gas. I believe those people overlook the fact that if Russia uses gas against Germany, then Germany can immediately use gas against Britain without any fear of being blamed for the first use of that particular weapon.

For that reason, I believe the Russians will hold off on the use of gas, the same as will Britain and the United States, in case we become involved. It is probable that all of the Ally countries will wait as long as it is humanly possible, or until Hitler first uses gas before resorting to that weapon.

Now let's see what is meant by the term "poison gas." Except for the fact that all gases used are not poisonous and the fact that all weapons of the Chemical Warfare Service are not gases, the term is just right—poison gas.

We do have a number of chemicals that are used in chemical warfare, and they are all gases, liquids or solids. The majority, in fact, are liquids or solids rather than true gases.

We usually divide up the chemical agents on the basis of their physiological effect, and I'd like to just briefly point out the effects of these various agents. For instance, **we have four gases of prime importance known as phosgene, chlorine, lewisite, and mustard gas.**

Now you will, of course, recognize mustard gas. It's very famous. You may have heard of lewisite. It is also famous, due to the fact that it has been publicized greatly. It was discovered years ago by some obscure chemist, but the method of preparing it in quantity was developed at the end of World War One by Professor Lewis of Northwestern University and was named after him, lewisite.

This particular gas is not the panacea for all of our ills. It doesn't do everything. It is an extremely poisonous gas, there is no doubt about it. It is a blistering agent. When it enters the system, it causes stomach poisoning, due to the fact that it's an arsenic compound. All those things are true about lewisite, but on the other hand lewisite is an expensive material to prepare and costs a number of times more than mustard gas.

For that reason, it's considered by most authorities that in case of another serious use of chemicals, mustard gas will be the important agent again as it was during World War One

Now phosgene, we find at the school, has an odor of a silo or a hay field. The odor, of course, varies with the individual who smells the gas. One smells one thing; one smells another slightly different. Mustard gas smells like garlic to a great number of persons, like horse-radish, fried onions, even skunk to others.

But we have the lung irritants or the lung injuriant gases, such as phosgene and chlorine. Those two are really gases. Phosgene affects the lower lungs very rapidly when taken in large quantities, and the man may die within a very few minutes. Chlorine, the first gas used by the Germans in World War One, affects the upper respiratory passages, and fortunately, due to spasms in the upper respiratory tract, a number of people have been saved from death by that reflex action of those parts.

On breathing chlorine, they choke up and appear to be strangling from lack of air, but if removed quickly to clean air, they recover almost within an hour and with very few ill effects.

The next classification is the lachrymators. **Lachrymators are tear gases, cause severe weeping, pain in the eyes, but not a permanent disability.** I might say that the possible use of lachrymators is very small, due to the fact that they will not give a permanent effect.

Then we have the sterginators or the sneeze gases. These were developed first by the Germans to take care of a situation in which the Allies had developed gas masks, protecting them against ordinary gases. The Germans saw that by introducing a sneeze gas in the form of a very finely divided powder, they could cause sneezing, and, therefore, the removal of the masks.

The man would remove his mask and was poisoned by the other gases which were mixed along with the sneeze gases, a very clever way of getting around the wearing of a mask. Naturally, the fact that these smokes passed through a mask required a change in the construction of masks, and very quickly the allied countries redesigned their gas masks and provided them with a filter system which would remove not only the toxic gas, the true gas, but also the smoke.

> **Since that time the gas mask has been improved year by year, both by experimentation and by field use. At the present time, the United States Army Service Mask is about as comfortable a contrivance as you can put over your face and still live that we know of.**

I believe you can realize the psychological effect of getting into a gas mask for the first time. Some people hesitate greatly to cover up their noses and mouths with a gas mask. That makes us certain then that some training must be gone through before the hour of necessity comes. We can't wait until gas bombs and land mines containing gases are dropped in our cities before we begin the education of the public.

The last class of gases is the vesicants, and they are last but certainly not least. Vesicants are the two I mentioned—lewisite and mustard gas. They get their name from the fact that they blister the skin. They are burning gases, and, of course, they are poisonous as well as blistering.

I think it's understood by everyone that we would be better to be fully prepared in this country and not have to use our gas masks than to be caught without gas masks at some not too remote date. It seems to be a principle of war that the force which is best protected is the on that is not attacked.

> **If we are prepared for any emergency in the line of gas warfare, we stand a much smaller chance of being attacked by a very smart adversary, and we make a mistake by trying to sell Mr. Hitler short when it comes to an intelligent use of what forces he has.**

The British are very anxious to take care of this gas situation. They still carry their gas masks; they still have decontamination groups, and they train and exercise these decontamination parties the same as they do any other service. They are still looking forward to the possibility that gas may be used, and the British people carry their gas masks very religiously.

No one can possibly escape the effects of gas in case it's dumped on us. We have perfectly good information to show that all countries engaged in war at the present time have very large supplies of gas; and I think it's only a qustion of the right time before that will be used.

The British, in attempting to devise means of using gas to a little better advantage than anyone else, invented a method of spraying mustard gas, which is actually a liquid, from airplanes at a considerable height.

Now I might explain a little bit about the effects of mustard gas. A very small drop of mustard will cause a blister of much larger size than the drop; in fact, hundreds of times larger in size. You have undoubtedly seen these large raindrops in the summer during thunderstorms splatter out for half an inch in size.

> **I can assure you that one drop of mustard of that size will raise a blister on your body as large as your doubled fist. So an extremely small amount of mustard gas goes a long way.**

The British devised this spray with the hope that they would be able to spray large territories and get these concentrated drops rather than an extremely fine spray. Two hundred of those machines were left at Dunkirk, and Hitler now has their secret.

Which gases might be used? That's a question some of you are interested in. There's always the possibility that a foreign power might use phosgene in large quantities, if they thought it could be circulated through buildings, for instance, in which a large number of persons were gathered.

Phosgene is nonpersistent. With a little wind, it would be blown away in ten or fifteen minutes, and as soon as it is blown away, it's of no use; but **if it were dropped in large quantities, introduced into the ventilating systems of large industrial plants or department stores or any buildings in congested areas, you can imagine the total effect.**

Mustard gas and lewisite are undoubtedly the ones which will be used, if any. Those two can be sprinkled over very large territories. One airplane can spray an area 800 yards by 300 yards with a quantity of mustard gas sufficient to give from fifteen to twenty droplets per square foot.

Therefore, any one caught in that section in that type of spray would have fifteen or twenty possible spots on his clothing for every square foot of area he presented, which would be a potential blister and a large blister.

Imagine then what one airplane could do to Philadelphia by flying in the general direction above Broad Street. They'd make that street uninhabitable, and it would require a complete job of decontamination or you would have to evacuate the entire area.

It would be extremely difficult to evacuate the downtown area of a large city. If it's not evacuated, it has to be cleaned up. You can't just live in that atmosphere of mustard gas, even though you have a gas mask on.

Some people overlook the fact that even the gases arising from mustard gas—I speak, you notice, of mustard gas all the time when in reality it is a liquid—the vapors that arise from this liquid mustard will penetrate the clothing and blister anyone who is in that vapor for any period of time. It has a cumulative effect. A large quantity of gaseous mustard over a short period of time will give a burn. A small concentration of mustard over a longer period of time will give the same kind of burn.

That means then it is going to require some protection of the body for those persons who are forced to work in an atmosphere of mustard gas or who are given the duty of cleaning up a territory over which mustard has been spread.

Now we have protective clothing, and we have the gas mask, and we have protective salves which may be spread on the skin and will protect the skin against the attack of the fumes from mustard liquid. Those we regard in the Army as items of individual protection.

We expect that the Government of this country will supply all persons who need it, a gas mask and will supply all those persons who may work in concentrations of gas with protective clothing and possibly supply everyone with protective ointments.

Protective ointments may be rubbed on to keep the gases from reacting, or they may be rubbed on after one has been splashed with mustard and will thereby give some relief.

However, speaking of relief from mustard burns, I should tell you that any treatment to be effective for mustard must be accomplished within fifteen minutes; otherwise, there is no power can stop the blister that is going to follow the action of that mustard.

Therefore, you can picure the difficulty we'll have in case a metropolitan area is sprayed by very high-flying airplanes, so high possibly that we don't even realize they're present, and very shortly we're subjected to a fall of liquid mustard, small drops, which possibly we may not notice until many thousands of persons have been contaminated. Then it's a little late to deal with this.

You were told the other day by Captain Leonard that the British have devised bathing organizations in order to take care of people who are caught in a mustard shower, and that will probably call for changes of clothing for thousands of people and shower baths of kerosene first if they are badly splattered, followed by plenty of strong soap and hot water which will partially counteract the effects of these vesicant agents.

The protective clothing that is available will probably be purchased by the individual concerns for their decontamination squads and by city management for those of the civic groups.

Now, there are a number of types of protective clothing available. The alligator raincoat is an example of an impervious cloth which will shed mustard just like it sheds water; however, that type of suit is very uncomfortable to wear for any long period of time. If any of you people have ever been confined in one of those suits, which is zippered up the front and completely cuts the body away from the air and doesn't permit the body to breathe as it normally does, you know what I mean.

Now we come to the subject of collective protection. As has been pointed out to you, we don't expect large industrial concerns to completely remodel their establishments in order to take care of a possible gas attack; but **there is certainly no reason why concerns should not survey the required work to adapt their plants to a possible gas attack.**

Those persons who have central heating systems and forced air heating systems or ventilating systems can realize that if gas is dropped in the vicinity and some precaution is not taken, the entire plant will be flooded with poisonous gas.

There are certain filters designed to remove poison gases built on a large scale and very similar to the small canister used on a gas mask. Those filtering devices are not made by the Army for sale to civilians.

However, there is no secret about the fact that activated charcoal will absorb the poisonous gases. In other words, the activated charcoal attracts these poisonous molecules. They pass through somewhat like a magnet picks up iron products, and they are kept on the surface of the charcoal.

There is nothing to stop a concern from devising its own filtering system. Activated charcoal is easy to obtain, and we have a great deal of it in this country.

During World War One, it was a very hard thing to get. Some of you may remember the saving of peach stones and prune seeds and coconut shells and so forth. All the dense woods of that variety were saved in order to prepare activated charcoal. Now we find that activated charcoal can be made much better than the World War One variety out of ordinary woods, and as far as I know there is no priority on it.

In an industrial building, you have the matter of windows, and that was discussed the other day. I don't believe any definite decision was made as to what you would do about windows; but you can realize if you are going to gas proof any large building you will have to, in some way or other, take care of the possibility of broken windows, or then you don't have a gas-proof building. Your ventilating system then is of no consequence. The gas can come in any broken window.

There are ways, of course, of constructing a building so that would not happen, but it would be at great expense. Possibly some concerns have already investigated the possibility of removing all of their windows and storing them in some safe place—I mean the glass and frames—and substituting in their place board or canvass or some other covering.

Even in that case, blast effect will open up places in the building, and some arrangements will have to be made to quickly close those in order to keep gas out.

The matter of the protection of groups of people has attracted the attention of a number of writers. In Britain, as was mentioned to you yesterday, there is a growing tendency to keep the citizen in his own home. The Morrison shelter was mentioned as being a steel-topped table under which the occupants of the house can sleep, and in case the house falls in on them, they are very safely snuggled there under the table top and can be dug out later on.

In case of gas warfare, the picture is going to change a little bit. You are going to have to have some way of keeping the gas out. Also you wouldn't be safe under your Morrison shelter in case gas was loosed in the vicinity. In that case it might be necessary to wear a gas mask and even protective clothing until you were rescued from that position.

After we have been gassed, and the mustard has been spread around the neighborhood, something must be done to clean up. We call it decontaminating. I will very briefly finish my remarks by explaining what we mean.

The decontamination process is to chemically destroy the mustard that has been spread around. Nature does a very good job of decontamination, but requires a lot of time.

When mustard gas is spread in countries where the weather is rather warm on the average and there is plenty of wind blowing, the mustard may remain in place for several days. Where it's cold and where the mustard might be under trees or in brush, it may remain for weeks, and that entire area must be evacuated. Anyone going into it over those several weeks' time may become a casualty, and when I speak of brush and trees, you realize that a building which is contaminated will be a source of mustard vapors the same as brush or trees would be.

We would, therefore, recommend that a territory be evacuated, if possible. Get the people out of the territory, and let nature do its work. That's the first thing to do, if possible; but you realize sometimes it's impossible to evacuate a territory.

It must be used; the buildings in it may contain establishments that must continue to function—telephone offices, fire departments, fire stations, police stations, and other public utilities must continue to function in spite of the gas that's present. Therefore, decontamination is called for.

Now mustard can be destroyed by burning, and if the area that has been contaminated is just ordinary grass, it might be possible to go in there and burn off the entire area, being sure that no one is down wind to receive the benefit of the very heavy concentration of vapors that would come off that flame.

It has even been found that mustard can be burned off with blow torches, large-size torches even, by putting gasoline on the area. Green grass doesn't burn well; spray it with gasoline and burn it off, and that does a very good job.

Then we have a chemical that some of you may be familiar with known as bleaching powder; and bleaching powder is undoubtedly the number one decontamination agent. It's a white powder and smells very strongly of chlorine. In fact, it's made by passing chlorine over quicklime. In destroying mustard, we do not want to apply the straight bleaching powder to the mustard, because they react very vigorously chemically, usually with a free flame and, of course, high concentration of mustard vapors.

> **So we mix the bleaching powder either with earth, two parts of earth to one of bleaching powder, or else we mix it with water, fifty-fifty, forming a very thick whitewash material. Now that material can be painted on floors or walls, even ceilings, and will completely destroy the mustard.**

There are other materials that can be used that you will find in the home—zonite, chlorox, and other forms of sodium hydrochloride are valuable in the decontamination process.

The Army has a decontamination agent, noncorrosive, rather an expensive chemical, but one which is nowhere nearly as corrosive on metals as bleaching powder is. Bleaching powder will react very vigorously with metals, causing them to be tarnished and in some cases eaten away rapidly, so it can't be used in every case.

I am sorry if I have painted a rather gloomy picture on the subject of chemical warfare, but I don't believe there is any sense in being an ostrich and burying our heads in the sand and refusing to appreciate the fact that such a weapon does exist and that we do have such an enemy that the use of a chemical weapon would certainly meet his needs. I, therefore, think we should be ready to handle the situation when it comes.

QUESTIONS

Q. Do I understand that was 800 by 300 yards in one airplane?

A. Yes, 800 yards by 300 yards. That, of course, is a model size tank of mustard gas.

Q. How long would mustard gas last if you couldn't destroy it by fire?

A. I can only say in some sections where you don't have good ventilation, and the sunlight doesn't hit, and the temperature is never very high, it might last several weeks; in other cases only several days. In fact, where the temperature is extremely high and there is a lot of circulation, we feel that a slight contamination will clear up in several hours. So it's rather a difficult matter to be too exact on the length of time which this material will last.

Q. After mustard liquid has vaporized, is there any way of knowing exactly the extent of contamination from that vapor.

A. As soon as the mustard has vaporized, the danger is over. As long as the mustard remains there in small spotches all over the vegetation and the ground, there's a constant rise of vapors from those droplets, and until that mustard gas has completely evaporated, the danger exists.

Q. Is it correct that cellophane can be used as a protection against mustard gas?

A. Yes, cellophane has shown itself to be very resistant to mustard gas. Very thin sheets of cellophane will keep mustard gas from passing through them for a time of about 1,400 minutes; whereas there are certain other materials which have passed mustard even though they seem to be much thicker in as low as 20 or 30 minutes. It looks as though cellophane has considerable use in that regard.

Q. Does vegetation show any indication of the presence of mustard gas?

A. Anyone trained in the detection of mustard, and of course we expect all of our air raid wardens to take it, can tell mustard gas is there in two ways—they can smell it; secondly, they can see the mustard gas on the vegetation and on the buildings. It looks very much like light lubricating oil.

Q. Why is it called mustard, on account of the smell?

A. Yes. Mustard was given its name because the British thought it smelled like true mustard, and they called it mustard and that name has stuck. It has no relationship to mustard, the kind you put on your hot dogs.

PROTECTION OF SCHOOL BUILDINGS

By JAMES MARSHALL
President of the Board of Education,
City of New York

Two years before the war—before the battle fleets were ready for action or the planes and tanks moved in quantity off the assembly line, Great Britain prepared plans for the protection of its children in the event of war. Mr. Chamberlain did not know at Munich how he could fight but his Ministry of Health and his Home Ministry and the London County Council knew how they could protect children.

Those nations which prepared their civilians for the effects of war have given the best account of themselves in resisting Blitzkrieg.

> **I think it can safely be said that no greater damage can be done to the morale of the community than through doing harm to its children. There is no more important phase of civilian defense than the protection of our children.**

There is no parent who is not vitally interested in plans for the protection of children. And there is no agency better organized and better qualified by generations of experience than the school to give this protection.

Because of the swiftness of the modern war of movement, emergency organization cannot be left to the moment when bombs fall, if they ever do. It requires time to prepare effective administration and organization. It takes time to train teachers and children in those procedures which are necessary for the protection of children and school property.

> **A month is not too long a time for city schools to survey the safest sections of their buildings in which to house children, for the development of dismissal procedures and for the planning of methods of assembling of children and keeping them from hysteria during air raids.**

Months are required, too, to select, obtain and install necessary equipment.

While the Atlantic seaboard is naturally more conscious today of the dangers of bombing, whether it be systematic or token bombing, the rapid technical development of the airplane gives to the central sections of our country no guaranty of immunity. The danger area is estimated to extend about 300 miles inland; 300 miles is less than an hour's flight from the sea.

Planning for the defense of children is not, therefore, merely a matter of concern to seaboard communities. **Thought must be given by other communities to the protection of their children** and as we are, after all, one country, the development of defensive techniques is not the problem of any one section. Each part is entitled to the interest and the best thinking of the whole nation.

> **I have no question that if war should come the people will look to the schools to take charge of their children. That is just what the people of Great Britain have done.**

That is what is normally to be expected, for parents have come to regard schools and school services as their guides and friends in matters concerning their children. The schools cannot, therefore, be without plans at such a time as this.

They cannot say that the protection of children from war raids is not in the curriculum or the State law which vests powers in boards of education. Schools have assumed the task in normal times of caring for the physical well-being and the morale of children. And they will not shirk their care of morale and physical well-being in time of crisis.

As in all matters of defense, for the **schools** to be forewarned is in large measure to be forearmed. To have thought about problems and projected plans, necessarily tentative, is the surest way to be prepared to render service.

It may be said that the chances of damage or harm to children are slight. But so are the chances of fires breaking out in schools. Nevertheless, we regard them as a distinct possibility. We plan and practice fire drills year after year on the possibility that some time a fire might necessitate calm and orderly exit from the schools.

It seems to me that we must prepare for school defense in the same spirit; not that we expect that every school or for that matter any school will be struck by a bomb, but that the possibility is there and we can never clear our own consciences or explain away our lethargy if we ignored the possibility, gave it no second thought, made no preparation for the contingency.

I have already emphasized the civilian character of modern war and the bombing of cities which has occurred to terrify the civilians so as to interfere with efforts of defense. I have mentioned the importance of civilian morale.

Now, some thinking has been done on the place of schools in civilian defense. I know that Superintendent Stoddard and his staff have done work for the protection of the children and schools of Philadelphia. The city of Newark, the first city in the country to experiment with black-outs, has developed some excellent plans for the protection of children and the education of the community in the problems arising out of the present state of world affairs.

In New York City, after school closed last summer, we conducted a three-day meeting of 1,500 supervisors. In the mornings we had talks from the Chief of Staff of the Second Corps Area; from a representative of the Fire Department who had been in London during air raids, from the Assistant Chief Inspector of the Police Department in charge of air raid warden service; from an engineer in the city service; and from the Health Department.

And each of these talks was translated into school terms and situations by members of our staff. In the afternoons, group meetings were held at which the conferees discussed the morning program in relation to the specific problems of their own schools.

Because there is a job for school people to do, Mayor La-Guardia has issued instructions to the school group that they are not to tie themselves up with other defense efforts.

He recognizes that they are the best skilled people in dealing with children and their problems; that teachers are equipped to instruct adults in the problems of defense and that they are in continual contact with the parents of children.

He recognizes also that the schools have organization, that difficult thing to create in a hurry; an organization which is efficient and which it is impossible readily to create or replace. Others would have to struggle for years to get the organization which we have at hand.

Last September, the Office of Civilian Defense called a meeting in Washington to draw up plans for the civilian defense of schools to be submitted to every school district in the country for its consideration and adaptation to local needs. There were about fifteen of us called in, representing public school systems in many of the larger cities and also representatives of large parochial school systems.

We prepared a plan which is now in the hands of the printer, and which we expect will be ready for distribution in the near future. I shall not attempt to give you the content of that report. It would be unfair to you and to the authors of the report to treat it as summarily as I would have to here today.

But the problem to our minds divided itself into two sections,—**that dealing with the building of morale by improving the understanding of our democracy and strengthening our faith in it, and that dealing with the physical care of school children and the physical care of school property.**

I want to point out some of the headings which must be considered under these several topics, headings which have been considered not only in Washington, but specifically, in Newark and in New York City.

We must plan for the disposition of children.

Are they to be dispersed?

Are they to be held in school during daylight raids and in either event how should they and their teachers be organized and disciplined for whatever they may be called upon to do?

There is the problem of repair and damage, not merely to buildings but to children, resulting from fear or sleeplessness caused by night raids.

There is the problem of providing nutrition if the food supply should be disorganized; of providing recreation to keep children out of danger and out of the way of workers. Children who had to see what was going on were one of the pests of London immediately following air raids.

More than ever, the schools in a war emergency would have to face the problem of truancy and delinquency.

In that interesting pamphlet, "English Cities at War," the story of the British children is told. From 1931 to 1940, indictable offenses committed by children under fourteen increased 62 per cent; by children fourteen to seventeen, 41 per cent; by young people eighteen to twenty-one, 21 per cent; and by the population over twenty-one, nine per cent.

This is an index, it seems to me, of the demoralization of young people caused by war. Here again, if war comes, the schools will have an increased burden of an old responsibility. They will have to use their imaginations as never before to meet this challenge.

Another matter which must be considered will be the use of parents' organizations and older children in possible first aid, in policing schools and in repairs.

We have considered also the possibility of evacuation. It is our duty to consider it, but I hope that evacuation will only be thought of as a last resort, for it holds perils of a social nature as great as the peril of bombing.

Evacuation is a dramatic thing, and there is great danger that its consideration may be exploited for personal and political reasons; **and so I want to warn you against this and urge upon you to distinguish between the hysterical advocacy of evacuation or whooping it up and planning for the possible eventuality.**

But to my mind the less talk of evacuation the better. The more effectively, shall we then be able to devote ourselves to school defense in the home community.

With all of these matters to be considered and planned, the schools must continue their first function of teaching. Even in war and under bombing, education must go on if we wish our civilization, our way of life, to survive.

Again, I must stress the essential problem of organization, whether for the care of property or children; and, in larger communities the need for decentralization so that each unit can be prepared to act on its own in the event that communications are interrupted.

The principal who does not know what to do in emergency will be helpless and endanger hundreds of lives if he has to wait to get through to the superintendent and the telephone exchange is jammed or out of order.

Then, of course, there is the important problem of coordination of the schools with all other community efforts. We have to cooperate with the Police Department, the Fire Department, with the Army, the Health Services, the Sanitary Services and the parents; and we have to keep other governmental agencies, except in extremity, from using school buildings for non-school purposes, and thus preventing us from doing our job.

I have mentioned that, in addition to the protection of children and school property, schools have a responsibility in the morale efforts of defense. The schools are in normal times vested with the duty to teach and explain the principles of democracy and to develop democratic attitudes.

Now, we can sit back and take our chances, if our loathing of totalitarian concepts and methods in Germany, in Italy, in Japan, and in Russia, is meaningless; or if we really do not care whether we have a totalitarian form of organization or of life, just so long as it is American and not imported.

But if we do care, then we cannot abdicate at this time our duties to understand and explain democracy and to develop democratic attitudes in our students.

QUESTIONS

Q. May I ask what you would suggest doing in a school, not of secular nature, which has no native defense paraphernalia? **What would you do if your students had to be kept in during a surprise raid?**

A. I don't believe any schools yet have very much defense paraphernalia. Some of our custodians or janitors may have some sand at hand and a few shovels, but none of us have been supplied adequately yet. Personally, I don't know how local communities can afford to buy the necessary supplies.

I think it has to be financed eventually by the Federal Government, but I think that it would be a good idea for every community to organize a school defense council, such as we are planning in New York, which will include representatives of the public schools, the parochial schools, and the private schools, to consider all of these matters in common, so that you don't have any group of children in the city not well protected merely because they don't happen to go to the public schools.

Q. Could you tell us along what lines, if any, your School Department in New York City has thought out any physical protection in the way of shelters, either in basements or outside playground shelters, for schools if they are suddenly surprised by a bombardment, and what sort would you recommend, if you got that far?

A. We have thought of two things—the desirability of getting children home if there is enough time; and we have practiced various procedures for getting children home, depending upon how far they live from school. In other words, the elementary school children, the young children, go to school near home. We have developed drills by which we can escort those children to their homes through the teachers. It's a variation of the old-fashioned fire drill.

Junior high school children we are now escorting away from the school to about a block or two away so they are on their way home; but they live further away and can travel better under their own power. We can't actually take all of them home. They have to travel too far. It may be if we don't get enough air raid warning we won't let those children go home at all.

High school children who have to travel far, we don't plan to let go home. All of these children, plus handicapped children, we plan to keep in the safest parts of the school building. Some school buildings, frankly, have no safe parts. Some school buildings have safer parts. We have been told not to let children be in the basement or on the ground floor because of the danger from gas and fragmentation. We have been told not to leave them in the outside classrooms, but to put them in corridors above the first floor; where there is glass, to protect that glass in some way so that it won't break in the corridors on them.

Now that implies also an obligation on teachers and students to develop some kind of entertainment. **If you have to keep kids sitting in an average corridor, all cramped up together, it involves very important problems of morale, of developing either their own little local orchestras or speeches or songs or one thing and another; and we have programs of that sort being worked on now.**

It involves also the very important question of having ready access to drinking water, of having ready access to lavatories, and of having the necessary emergency supplies of water. If you have the first raid, you can't do it; but if you expect more raids you just have to have in your schools in each corridor some receptacle which can have an emergency supply of water if your water is cut off from the school.

It also involves the problem of having a first-aid organization in every school, and that means teachers of the older grades will also have children who can help in the first aid. There are all kinds of other complications, but I don't think you can have any one formula; and even where we talk about taking the children home from school, if we have twenty minutes' warning we can take most of the elementary children home; if we have ten minutes' warning, we would not dare send anybody home.

Q. Do I understand that there are plans in preparation now that will be disseminated through the various school organizations? **Are these things you mentioned in your speech covered in this booklet which is now in preparation?**

A. They are covered in that booklet, yes. I don't know if it will tell you every detail. Some of them you will have to work out in your own community, because every community has a somewhat different problem.

Q. What plans are being made for the disposition of patients in hospitals?

A. I don't know, I only know about schools. I might say as to children who are handicapped, it would be our idea that if we have any indication of a substantial number of raids, we will permit none of them to go to school, but do home teaching for them.

Q. In working for the physical needs of children, is there any specific training program for teachers in caring for the physical needs of children, for instance, first aid, and things of that type?

A. I think it is very important that as many teachers as possible take the Red Cross Course. We have in our system—we are fortunate in one sense of being a large system—we can have enough people trained in our system to go on training other teachers, but is very important to do that. I am told the Air Raid Warden Schools will also give such training.

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